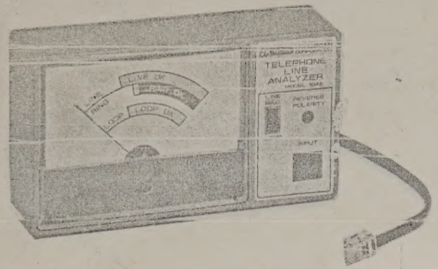
INSTRUCTION
FOLDER

B&K PRECISION 1042

TELEPHONE LINE ANALYZER



B&K PRECISION DYNASCAN CORPORATION

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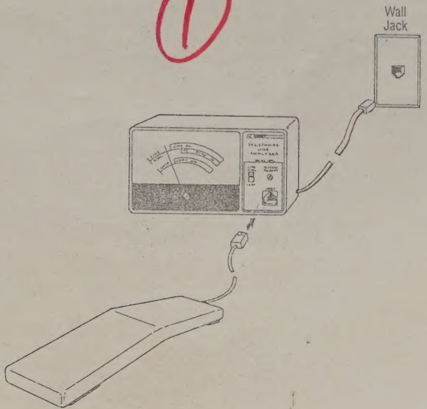
SIMPLIFIED INSTRUCTIONS

For more detailed explanations, see OPERATING INSTRUCTIONS



LINE TEST

1. Connect unit and telephone as shown and hang up all telephone products on the line.
2. Set switch to LINE/RING position.
3. Reading should be in the LINE OK area.
4. Pick up telephone.
5. Reading should drop to near zero deflection and return to LINE OK when telephone is hung up.

RING TEST

1. Connect unit and telephone as shown and hang up all telephone products on the line.
2. Set switch to LINE/RING position.
3. Have someone call your number.
4. Reading should be in RING OK area (needle will vibrate) during ringing.

LOOP TEST

1. Connect unit and telephone as shown and hang up all telephone products on the line.
2. Set switch to LOOP position.
3. Reading should be in the LOOP OK area.
4. Do not leave in LOOP position; calls can not be received and callers will get busy signal.

TELEPHONE CORD TEST

It is only necessary to perform this test if other tests indicate a good telephone line, telephone is still inoperative, and the telephone cord is detachable at both ends.

1. Connect telephone cord between wall jack and jack on Analyzer and plug analyzer's cord into telephone.
2. Set switch to LINE/RING position.
3. While observing the reading, bunch the cord up, squeeze it, and release it.
4. If there is no reading or the reading fluctuates, the cord is defective and must be replaced.

WARRANTY SERVICE INSTRUCTIONS
(For U.S.A. and its Overseas Territories)

To send in the unit for servicing, pack it securely (preferably double-packed). Enclose a letter describing the problem and include your name and address. Deliver to, or ship PREPAID (UPS preferred in U.S.A.) to the nearest **B & K-Precision** authorized service agency (see list enclosed with unit).

If your list of authorized **B & K-Precision** service agencies has been misplaced, contact your distributor for the name of your nearest service agency, or write to:

B & K-Precision, Dynascan Corporation
Factory Service Operations
4050 North Ravenswood Avenue
Chicago, Illinois 60613
Tel (312) 327-7270
Telex: 25-3475

Also use this address for technical inquiries and replacement parts orders.

B+K PRECISION DYNASCAN CORPORATION
6460 West Cortland
Chicago, Illinois 60635

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481-161-9-001 Printed in Korea

LIMITED 90-DAY WARRANTY

DYNASCAN CORPORATION warrants to the original purchaser that its **B & K-Precision** product, and the component parts thereof, will be free from defects in workmanship and materials for a period of 90 days from the date of purchase.

DYNASCAN will, without charge, repair or replace, at its option, defective product or component parts upon delivery to an authorized **B & K-Precision** service contractor or the factory service department, accompanied by proof of the purchase date in the form of a sales receipt.

Exclusions: This warranty does not apply in the event of misuse or abuse of the product or as a result of unauthorized alterations or repairs. It is void if the serial number is altered, defaced or removed.

DYNASCAN shall not be liable for any consequential damages, including without limitation damages resulting from loss of use. Some states do not allow limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

This warranty gives you specific rights and you may also have other rights which vary from state to state.

For your convenience we suggest you contact your **B & K-Precision** distributor, who may be authorized to make repairs or can refer you to the nearest service contractor. If warranty service cannot be obtained locally, please send the unit to **B & K-Precision** Service Department, 4050 North Ravenswood Avenue, Chicago, Illinois 60613, properly packaged to avoid damage in shipment.

B & K-Precision Test Instruments warrants products sold only in the U.S.A. and its overseas territories. In other countries, each distributor warrants the B & K-Precision products which it sells.

SPECIFICATIONS

DC LINE TEST	
Switch Position:	LINE/RING.
LINE OK:	40 Vdc to 121 Vdc full scale.
Accuracy:	±3% of reading at 40 Vdc.
REVERSE POLARITY:	Indicator on for reverse telephone line polarity (tip voltage negative with respect to the ring conductor).
RING TEST	
Switch Position:	LINE/RING
RING "?":	40 Vrms to 50 Vrms, 20 Hz superimposed on 48 Vdc.
RING OK:	50 Vrms to 130 Vrms, 20 Hz full scale superimposed on 48 Vdc. The REVERSE POLARITY indicator flickers during RING TEST.
LOOP TEST	
Switch Position:	LOOP.
LOOP OK:	Lower end of "LOOP OK" scale corresponds to 20 mA dc developed across 200 Ω internal load. Full scale corresponds to 60 mA.
Accuracy:	±3% of reading at 20 mA dc.
GENERAL:	INPUT jack accepts RJ-11 type plug. Attached telephone cord terminated in 6-position RJ-11 plug.
OPERATING TEMPERATURE:	0° to 50°C.
PHYSICAL SIZE:	HWD (2.75 x 5 x 1.5") (7 x 12.7 x 3.8 cm).
WEIGHT:	7.5 oz (.2 kg).

OPERATING INSTRUCTIONS

LINE TEST

1. Disconnect telephone from wall jack and plug it into INPUT jack on front panel of analyzer.
2. With the analyzer's switch in the LINE/RING position, connect the plug from the analyzer into the modular wall jack. The analyzer can now monitor line conditions with the user's telephone operating. With the telephone hung up (on hook), the analyzer's meter will read the DC voltage that is present on the telephone line.
3. The meter should read in the LINE OK area. If it doesn't, first verify that all telephone devices on the line under test are hung up (on hook). If they are, unplug one device at a time and observe the meter. If unplugging a particular device causes the meter reading to increase, it is likely that the device is defective. A properly operating device causes negligible line loading when hung up. If new wiring has been installed, particularly by the do-it-yourselfer, it should be re-examined and possibly disconnected to verify that it is not loading or shorting the incoming line.
4. If the REVERSE POLARITY Indicator lights, it indicates that the telephone line polarity is reversed. This may be the cause of an operating problem if the telephone is polarity sensitive. All line tests can be made with either polarity (with the REVERSE POLARITY Indicator ON or OFF).
5. Once an acceptable line voltage reading is obtained, pick up each telephone device (go off-hook) and observe the meter. The reading should drop to near zero deflection and return to the normal reading when hung up.

RING TEST

If ring voltage is not in the RING OK area, check ring voltage at intervals. If total loading on exchange is heavy, ring voltage could be temporarily low. The telephone company's master ring source only has a certain amount of power available.

1. If line voltage appears OK, dial a ring-back number (if available) or have someone call you. When the telephone rings, the meter reading should increase into the RING OK area for the duration of the ring; the pointer will vibrate during ringing. Deflection should be at least 1/8" past the LINE TEST reading. This means that if during the LINE TEST the pointer was already in the RING OK area or very close, the needle should deflect an additional 1/8" or more toward the high end of the scale (measured along the line that separates the RING/LINE scale) during this test.
2. If the telephone does not ring but the meter reading increases into the RING OK area, the telephone's ringer circuit may be defective.
3. If the telephone does not ring and the meter reading is not in the RING OK area, it may be caused by having a large number of telephone products on the line. This may load the ringing signal to the point where it will not ring all the telephone products connected. To determine if this is the problem, add up the ringer equivalence numbers (R.E.N.) indicated on each telephone product. If the total is five or greater, you have exceeded the total ringer equivalence that the telephone company guarantees to ring.
4. Disconnect telephone products one at a time and repeat the RING TEST.

5. If only one telephone is plugged into the line and a low ring reading is observed, unplug the telephone from the analyzer's jack and check whether the ring voltage reading increases significantly. If there is a large increase in the reading, the ringer circuit of the telephone may be defective. If the increase is very small and the meter reading remains in the marginal area, there is a ring voltage problem. Before calling the telephone company, make sure that modifications performed by the user are not the cause of the problem.

NOTE

When the meter reading during this test is in the RING "?" area of the scale, the ringing signal is very close to the minimum voltage guaranteed by the telephone company. Not all telephones will ring in this situation.

LOOP TEST

This test verifies the condition of the telephone line from the central office to the telephone jack in the home.

1. If the "LINE TEST" and "RING TEST" produced low readings after performing all additional checks suggested, the telephone line itself may be the cause of the problem.
2. With all telephone products hung up (on hook), and the analyzer connected as originally instructed (the telephone plugged into the INPUT jack on the analyzer and the analyzer plugged into the wall jack), place the analyzer's switch in the LOOP position. If the meter reading is not in the LOOP OK area, once again, before calling the telephone company, check all telephone products by unplugging one at a time and observing the meter.

3. Before calling the telephone company, repeat the test several times at 15 minute intervals to determine if it is a temporary condition.

NOTE

Do not leave the analyzer connected to the telephone line with the LOOP test selected. This test simulates an off-hook condition. A party attempting to call you will get a busy signal.

TELEPHONE CORD TEST

With the analyzer and the telephone still connected as originally instructed (the telephone plugged into the jack on the analyzer, the analyzer plugged into the wall jack, and the switch on the analyzer in the LINE/RING position), the analyzer may indicate acceptable readings but the telephone may still be inoperative. If so, the telephone cord (between the wall jack and the telephone) may be defective. This test can only be performed on telephone cords that are detachable at both ends.

1. If the telephone line cord is detachable, verify that both ends are properly seated in their sockets.
2. If the telephone is still inoperative, connect the telephone cord between the wall jack and the jack on the analyzer and plug the analyzer's cord into the telephone.
3. Select the LINE/RING test position on the analyzer and, bunch the cord up, squeeze it and release it while checking for abrupt changes in the meter reading.
4. Move the cord up and down and back and forth near each plug and observe the meter.
5. If there is no reading or if the reading fluctuates during steps 3 and 4, the cord is defective and must be replaced.

PARTS LIST AND SCHEMATIC DIAGRAM

PARTS LIST

DESCRIPTION	DYNASCAN PART NO.
RESISTORS	
Unlisted resistors are ±5%, 1/4 W. See schematic diagram for value.	
200 Ω ±5%, 1W	002-001-5-201
100 kΩ Trimmer Pot	008-228-9-001
30 kΩ Trimmer Pot	008-230-9-001
MISCELLANEOUS	
Diode, 1N4004	151-050-9-001
LED, Red	158-057-9-001
Slide Switch, DPDT	084-133-9-001
Panel Meter, 1 mA	320-129-9-001
Modular Jack	777-026-9-001
Modular Cord (RJ-11 with 4' cord)	428-058-9-001
Front Case	271-227-9-001
Back Case	271-228-9-001

CALIBRATION PROCEDURE

1. Set S1 to LINE/RING position. Apply 40 VDC to line input with polarity as shown. Adjust R1 so that needle just touches LINE OK area on M1.
2. Reverse polarity of input voltage. REVERSE POLARITY LED should light and M1 should read within 5% of reading in step 1.
3. Apply a 40 Vrms, 0 Hz signal riding at a 48 VDC level to line input. Reading should be within 5% of lowest area on "RING ?" (on M1).
4. Set switch S1 to LOOP position. Apply 20 mADC to line input. Adjust R2 so that the needle just touches LOOP OK area of M1.

PARTS ORDERING INFORMATION

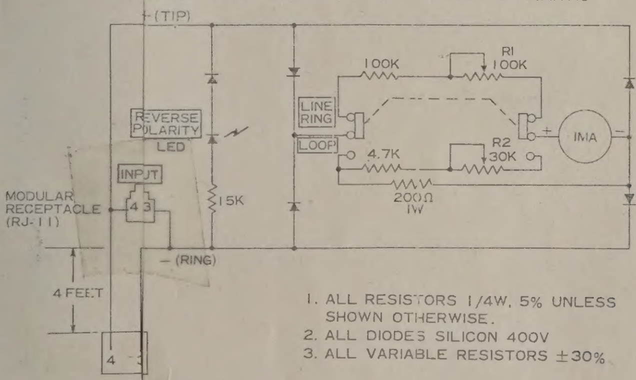
There is a minimum charge for each invoice. Orders will be shipped C.O.D. unless previous open account arrangements have been made or remittance accompanies order. Advance remittance must cover handling and postage or express charges. Specify model and serial number when ordering replacement parts.

ORDER REPLACEMENT PARTS FROM:

B & K-Precision, Dynascan Corporation
Factory Service Operations
4050 North Ravenswood Avenue
Chicago, Illinois 60613
Teléphone (312) 327-7270
Telex: 25-3475

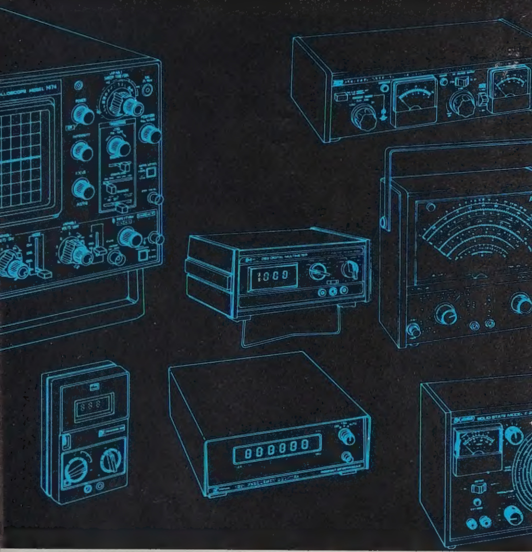
Also use this address for technical inquiries.

MODEL 1042 TELEPHONE LINE TESTER SCHEMATIC



1. ALL RESISTORS 1/4W, 5% UNLESS SHOWN OTHERWISE.
2. ALL DIODES SILICON 400V
3. ALL VARIABLE RESISTORS ±30%

PRODUCTS OF DYNASCAN CORPORATION



B+K PRECISION

TEST INSTRUMENTS

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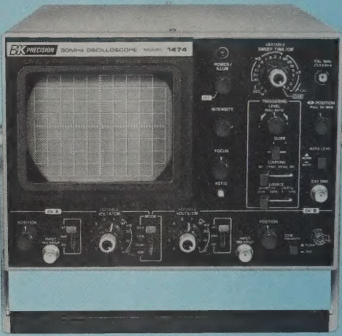
DYNASCAN CORPORATION

CATALOG BK-7

New Dual-Trace 5″ 30MHz Triggered Scope With Signal Delay



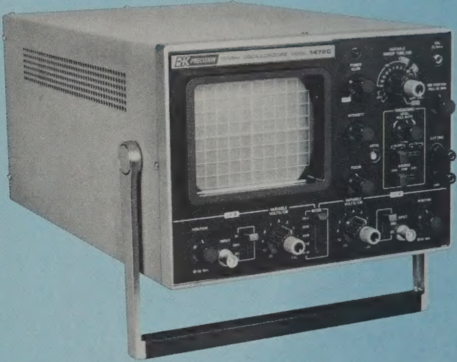
B&K-PRECISION
Model
1474

APPLICATIONS: Microprocessors system development...Analysis and troubleshooting of mini-computer and microprocessors...Computer terminals...Video character generators...Video games...Broadcast studio application...Monitor CB waveforms, both AM and SSB...Monitor digital data transmissions...Logic and digital design work and troubleshooting, including electronic organs, counters, calculators, phase-locked-loops, DMM's and synthesizers...Check the divider network of any system using TTL, DTL, RTL and most ECL logic...Measure propagation delays and phase shifts...Troubleshoot and maintain video recording systems and equipment...Set sync, video and color burst levels in video systems with extreme accuracy...Use A-B mode to compare amplifier input/output waveforms and display algebraic difference as a distortion curve.

FEATURES: • Rise time 11.7 nS • Built-in signal delay line permits view of leading edge of high frequency pulse rise time • Triggers on signals up to 50 MHz • Mode automatically shifts between CHOP and ALTERNATE as sweep time changes • High accuracy ten position vertical input attenuator • Bright P31 blue phosphor • Built-in high and low pass filters • 20 calibrated sweeps—0.2 µS/cm-0.5 S/cm • Differential input capability • Algebraic addition and subtraction • Die-cast front panel.

SPECIFICATIONS **Vertical Amplifier**—Sensitivity: 5mV/cm. Response: DC, DC-30 MHz (−3 dB); AC, 10Hz-30 MHz (−3 dB). Rise time: 11.7 nS. Overshoot: 3% or less. Input Impedance: 1MΩ±2%, 22 pF (±3pF). Tilt: less than 5%. Maximum Input: 300V DC + AC peak or 600 V p-p. Operating Modes: CH-A, CH-B, Dual, Add. ALT 0.2 µS/cm-0.5 mS/cm. Chop 1 mS/cm-0.5 S/cm. Chop Frequency: 200 KHz ± 20%. Signal Delay: Fixed-12 nS. **Sweep System**—Type: Automatic and triggered (NORM) Mode (X-Y operation) CH A = Y, CH B + X. Sweep time: 0.2 µS/cm-0.5 S/cm ±3% in 20 calibrated steps in a 1-2-5 sequence with vernier adjustment. Horizontal Position Control (Pull for 5X mag.) Sweep Magnification: x5 ± 5%. Linearity: 3% or better. **Triggering**—Source: INT CH-A, CH-B and EXT; X1 and X.1 Slope: Positive or negative, continuously variable level control; pull for AUTO. Range: INT DC—5 MHz, .3 cm or less. 5 MHz-30 MHz, 1 cm or less. EXT DC—10MHz, 100 mV p-p or better. DC—30 MHz, 500 mV p-p or better. Coupling: AC, DC, LF reject, HF reject. **Horizontal Amplifier** (Input through Channel B vertical Input)—Sensitivity: 5 mV/cm. Response: DC-1 MHz (−3 dB). Input Impedance: 1 megohm (nominal), shunted by 22 pF (±3 pF). Input Protection: 300 VDC + AC peak, or 600V p-p. **Other Specifications**—Calibration: 0.5 V p-p ±1% (squarewave at 1 kHz ±10%). Intensity Modulation: More than +5V (TTL compatible). DC-5 MHz. **Power** 115/230VAC, 50/60 Hz, 25 W. Size: (HWD) 18.4 × 25.3 × 36.9 cm (7⅜ × 10⅛ × 14¾"). **Weight:** 8.8 kg. (19.6 lbs.). Probes: (not included) Two PR-36 probes required. Optional LC-74 protective cover available.

New Dual-Trace 5″ 15MHz Triggered Sweep Scope



B&K-PRECISION
Model

1472C

FEATURES: Mode automatically shifts between **CHOP and ALTERNATE** as sweep time changes for fast set-up • Bright P31 Blue phosphor • Flat in-band response with smooth roll-off past 15MHz • Maintains calibration accuracy over 105-130VAC range • Check most digital logic circuitry, including CMOS • Front-panel X-Y operation using matched vertical amps • Algebraic addition and subtraction • Differential input capability • 10 calibrated sweeps—.5 μSEC/cm to .5SEC/cm • Sweep to .1 μSEC/cm with 5x; 1.5SEC/cm with uncalibrated vernier • Monitor CB, AM and SSB • Adjust color video to close tolerances in TV broadcast studies & TV sync separators.

SPECIFICATIONS: Vertical Amplifier—Deflection Factor: 0.01V/cm to 20V/cm, ±5%, in 11 ranges, each with fine adjustment. Frequency Response: DC, DC-15MHz (−3dB); AC, 2Hz-15MHz (−3dB). Risetime: 24nSEC. Input Impedance: 1 megohm (approx.) shunted by 27pF (±3pF). Maximum Input Voltage: 300V, DC + AC peak or 600V p-p. Operating Modes: Channel A only; Channel B only; Dual Trace (A and B) —trace automatically chopped at all sweep times of 1mSEC/cm and slower, alternate mode automatically selected for all faster sweep times; A + B (single-trace algebraic sum of Channels A and B); A−B (single-trace algebraic difference of Channels A-B).

SWEEP: Auto and triggered. 0.5 μSEC/cm to 0.5SEC/cm in 19 ranges with vernier adjustment for each. Sweep Magnification: 5x at all speeds.

TRIGGERING—Source: CH A and CH B, 1cm deflection minimum. EXT, 1V p-p sensitivity. Slope: Positive and negative, continuously variable level control; pull for AUTO. Range: 20Hz-15MHz guaranteed (minimum 1cm deflection as measured on CRT); 20Hz-27MHz typical. TV Sync: Vertical and horizontal sync separator. Low Pass Filters: TV sync separators function as 100Hz-3kHz (TV-V) and 100Hz-1MHz (TV-H) filters.

HORIZONTAL AMPLIFIER (Input through Channel B vertical input)—Deflection Factor: 0.01/cm to 20V/cm, ±5%, in 11 ranges, each with fine adjustment. Frequency Response: DC-1MHz (−3dB). Input Protection: 300V, DC + AC peak, or 600V p-p.

OTHER—Calibration Voltage: 1kHz square wave. Intensity (Z-Axis) Modulation: 20V p-p minimum. Probes: Two PR-24's required, not supplied. Power Required: 115/230VAC, 50/60Hz, 23W; CSA-approved three-wire line cord. Size (HWD): 18.4 x 25.3 x 36.9 cm (7⅜ x 10⅛ x 14¾"). Weight: 8.8 kg. (19.6 lbs.). Probes: (not included) Two PR-35 probes required. LC-74 protective cover optional.

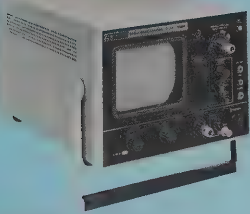
New Dual-Trace 5″ 10MHz Triggered Scope

B&K-PRECISION
Model
1471B

FEATURES: • Mode automatically shifts between **Chop and Alternate** as sweep time changes for fast set-up • Bright P31 blue phosphor • 18 calibrated sweeps-cm • Sweep to 200nSEC/cm with 5X magnification • TV sync separators • Check most digital logic circuitry • Character display applications using TTL compatible Z-axis intensity modulation.

SPECIFICATIONS: **Vertical Amplifier**—Sensitivity: 10mV/cm. Response: DC, DC-10MHz (−3dB); AC, 10Hz-10MHz (−3dB). Risetime: 35nSEC. Overshoot: 3% or less with 100kHz square wave. Input Impedance: 1 megohm (approx.) shunted by 25pf (± 3pF). Max Input: 300V DC + AC peak or 600V p-p. **Sweep System**—Type: Auto and triggered. Sweep Time: 1μSEC/cm to 0.5SEC/cm (±5%) in 18 ranges, in 1-2-5 seq. Magnification: 5x for max. sweep of 200nSEC/cm. **Triggering**—TV Sync: Vertical and horizontal sync separator provided. **Horizontal Amplifier**—Sensitivity: 0.01V/cm to 20V/cm, ±5%. Response: DC-1MHz (−3dB). X-Y Operation: With Sweep Time/CM switch in CH B position, the CH B input becomes the X input (horiz). **General**—Vector overlay: supplied for Vectorscope operation. Intensity (Z-Axis) Modulation: 5V p-p nominal. **Power:** 117/234V, 50/60Hz, 20W; CSA-approved three-wire cord. Size: 18.4 × 25.3 × 36.9 cm (7⅜ × 10⅛ × 14¾″). **Net Weight:** 8 kg (19.6 lbs.). Probes: Two PR-31 or PR-35 probes required (not supplied). LC-74 protective cover optional.

New 10MHz Triggered Sweep 5″ Oscilloscope

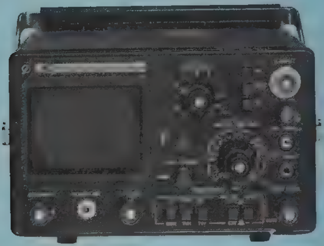


B&K-PRECISION
Model
1461

- 18 sweep range selections
- DC-10mV/cm sensitivity • Fully regulated... calibration is accurate from 105-130 V line. • Built-in calibration signal • Triggered and automatic sweep • Built-in TV vertical and horizontal sync separation circuits • Display smallest transistor and IC signal levels with positive sync. • Display and expand any portion of a complex TV waveform.

Vertical Amplifier—Sensitivity: 10mV/cm—Response: DC, DC-10MHz (3dB); AC, 2Hz-10MHz (−3dB). Risetime: 35nSEC. Max Input: 300VDC plus AC peak, or 600V p-p. **Sweep System**—Type: Auto and triggered. Sweep Time: 1μSEC/cm-.5SEC/cm, ±5%, 18 calibrated ranges, each with fine adjustment. Magnification: 5x for max sweep to .2μSEC/cm. Linearity: 5SEC/cm-2μSEC/cm, 3% or less; 1μSEC/cm, 5% or less. Triggering—TV Sync: Vertical and horizontal sync separator provided. **Horizontal Amplifier**—Sensitivity: 100mV/cm. Response: DC-800kHz (−3dB) Max Input: 300V (DC + AC Peak) or 600V p-p. X-Y Operation: Y (vertical) signal supplied to scope Input jack; X (horizontal) signal supplied to H Input jack. **General**—Intensity Modulation: 0-5 Vp-p (TTL logic-compatible). **Power:** 117 or 230 VAC, ±10%, 50/60 Hz, 20 watts. (3-wire line cord, CSA approved for oscilloscopes.) Size: (HWD) 18.4 × 25.3 × 36.9 (7⅜ × 10⅛ × 14¾″). **Weight:** 8 kg. (17.3 lbs.). Probes (Not included) Requires PR-31 or PR-35 combination 10:1 and direct probe. LC-74 protective cover optional.

3″ Triggered Sweep Oscilloscope



B&K-PRECISION
Model
1431

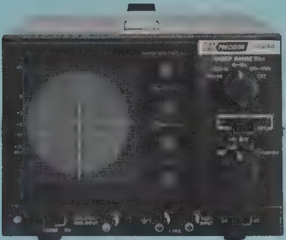
⅓ the size of comparably performing scopes
21 sweep positions
10MHz bandwidth

Triggered sweep and automatic sync in a solid-state 3″ scope. • Weighs just 13 pounds. • DC to 10MHz bandwidth and high sensitivity (10mV/div.) for extreme versatility. • 21 fully automatic sweep positions, including TV-V and TV-H for lightning-fast pattern lock-in. Super-bright patterns on flat face 3″ CRT. 5X magnifier shortens sweep time to enlarge patterns.

Vertical Amplifier—Sensitivity: 10mV/div. to 20V/div., ±5%. Response: DC, DC to 10MHz; AC, 2Hz to 10MHz (both −3dB). Risetime: 35nSEC. Impedance: 1 megohm/35pF. **Sweep**—Automatic and triggered, 0.5μSEC/div. to 0.5SEC/div. in 19 calibrated ranges. Magnification increases maximum sweep to 0.1μSEC/div. **Horizontal Amplifier**—Sensitivity: 300mV/cm. Response: DC to 800kHz (−3dB). **Other**—CRT: 3-inch. Size: 12⅞x4¾x7⅞″ high. 3-wire line cord. With handle/tilt stand and Mylar Vector overlay, not including probe.

LC-31 case optional.

New 3″ 5MHz Solid State Oscilloscope



For production lines, schools, field service work, hobbyists.

B&K-PRECISION
Model

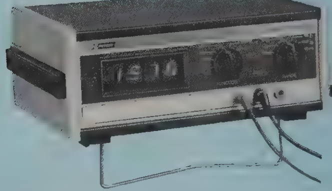
1403A

5MHz with high sensitivity • Direct deflection input for waveforms to 450MHz • Sharp bright trace • DC amplifiers on both axes • 10mV/div vertical sensitivity • Weighs only 8.5 lbs.

Improved circuitry makes the 1403A an outstanding value. Bandwidth now extends to 5MHz with a sensitivity of 10mV/div or better. With new high brightness CRT and smoked-glass filter, waveforms are clearer and easier to observe.

Vertical Amplifier—Sensitivity: 10mV/div or better. Response: DC, DC-5MHz (−3dB); AC, 2Hz-5MHz (−3dB). Max Input: 600V peak-to-peak. Input Impedance: 1 meg shunted by 35pF. Attenuator: 1, 1/10, 1/100 multiplier, ±5%. Gain Control Range: greater than 22dB. **Horizontal Amplifier**—Sensitivity: 300mV/division or better. Response: DC-250kHz. Max Input: 100Vp-p. **Sweep System**—Type: Recurrent. Time Base Ranges: 10-100Hz, 100-1000Hz, 1-10kHz, 10-100kHz; continuously variable between ranges. Sweep Linearity: ±5%. Sync: Internal, negative; external. **Direct Deflection Terminals:** 10V/division sensitivity or better. **General**—Intensity Modulation: 25Vp-p. Power: 117/234VAC, 50-60Hz, 10W; three-wire grounded line cord. Acc. incl.: Leads, spare fuse, instructions. Size: (HWD) 13.1 x 18 x 29 cm (5.25 x 7.25 x 11.5″). Weight: 3.8 kg. (8.5 lbs.). Probe: (optional) PR-21 required. LC-14 case optional.

NEW 3½ Digit Multimeter

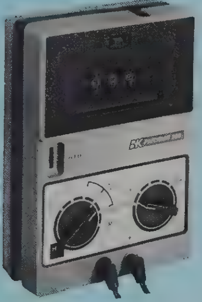


B&K-PRECISION
Model
283

High intensity, high reliability 3½-digit LED display for maximum readability • Selectable HI/LO power ohms function allows in-circuit resistance measurement • Easily installed optional battery pack • Large, bright non-blinking 7-segment digits • DC accuracy, 0.5% • Automatic polarity • Full overload protection on all ranges • 100% overrange • 1mV resolution • Test leads supplied with unit.

AC-DC Voltage—Ranges: ±1.000, 10.00, 100.0, 1000V. Max Input: 1500V peak or 1500VDC plus AC peak. DC Voltage: Accuracy: ±5%, ±1 digit, ±1.0%, ±1 digit, 1000V range. **AC Voltage**—Accuracy and Response: ±1%, ±1 L.S.D., 40-400Hz; 1000V range, ±1.5%. **AC and DC Current**—Ranges: ±0-1.000, 10.00, 100.0, 1000mA. DC Accuracy: ±1%, ±1 L.S.D. 1000mA range, ±1.5%, ±L.S.D. AC Accuracy: ±1.5%, ±L.S.D. 1000mA range, ±2%, ±1.5%, ±1L.S.D. Response: 40-400Hz. **Resistance**—Ranges: 0-100.0 ohms; 1.000K, 10.00K, 100.0K ohms; 1.000, 10.00 megohms. Accuracy: ±2%, ±1L.S.D. or better. **General**—Input Impedance: 10 megohms, all voltage ranges. Overrange: 100%, to 1.999, 19.99, 199.9 and 1999mA. **Power:** 105-125VAC, 50-60Hz; also available for 230VAC, 50/60Hz. With 3-wire grounded detachable AC line cord and test leads. Size (WDH): 23 × 18 × 9 cm (9 × 7 × 3.5"). **Weight:** 1.35 kg. (3 lbs.). **Optional Accessories:** Model BP-83 Rechargeable Battery Pack, Model PR-21 Isolation/Direct Probe, Model LC-83 Carrying Case.

Portable 3-Digit Multimeter

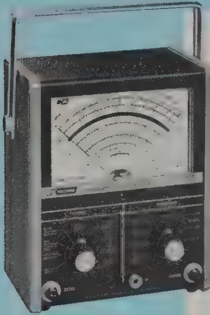


B&K-PRECISION
Model
280

RELIABLE fully overload protected to 1000VDC or AC RMS on all ranges. Built-in battery check. Impact-resistant Cycolac® case. **EASY TO READ** large 3-digit LED readout. Automatic polarity, decimal point and out-of-range indication. **COMPLETELY PORTABLE:** Operates from 4 ordinary "C" cells or AC with optional adapter/charger. **HIGH-LOW POWER OHMS**—measures accurately in solid state circuitry. 100mV, or 1V applied. Test current as low as 100nA on Lo or Hi ohms. **HIGH RESOLUTION**—1mV, 1μA, 0.1Ω. **DIGITAL ACCURACY**—DC volts typically ±1% F.S.; AC volts and ohms typically ±2% F.S. except ±2.5% on highest range. **RANGES**—DC and AC volts, 0-1, 10, 100, 1000V; DC and AC current, 0-1, 10, 100, 1000mA; Ohms, 0-100, 1K, 10K, 1 meg, 10 megs, 10 meg industry standard input impedance. **SIZE:** (HWD) 16 x 11 x 5 cm (6.4 x 4.4 x 2″).

Model BC-28 AC adapter/battery charger. Weight (1 lb.).
Model LC-28 carrying case. Weight, 450 g. (1 lb.).
Model MS-28 wire tilt stand. Weight, 450 g. (1 lb.).
Model BP-28 NiCd battery pack, 450 g. (1 lb.).
See page 36 for probes.

Solid State Portable Electronic Multimeter



WITH HIGH-LOW

A conventional ohmmeter's 1.5V supply could cause the emitter-base junction to conduct, shunting the 5K resistor and giving you a false resistance reading. But .1V or less supply on low-power ohms can't cause the junction to conduct. Read true resistance without concern for transistor or lead polarity! High-power ohms tests transistor or diode condition with front-to-back ratio test.

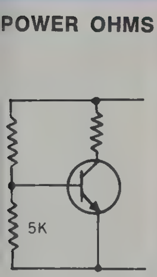
B&K-PRECISION
FET Meter Model

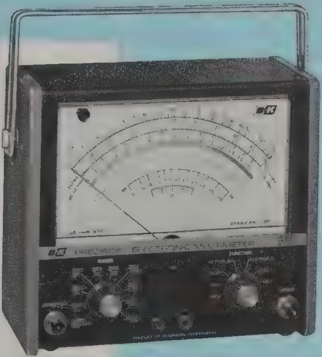
277

High-Lo power ohms • 1μA full scale current range for semiconductor leakage tests • 52 ranges; overload protected • Checks its own batteries • 4.5″ mirrored scale meter.

Protection: Meter and FET input fully overload protected; current and resistance by fuse. **DC Volts:** 0-.1 to 0-1000; zero-center capability; accuracy, ±2% F.S.; input impedance, 15 megs. **AC Volts:** RMS, 0-.1 to 0-1000; peak-to-peak, 0-.28 to 0-2800; accuracy, ±3% F.S.; input impedance, 10 megs, 100pF; frequency response, flat, 50Hz-150kHz. **DC Current:** 0-1, 10, 100μA; 0-1 to 0-1000mA; accuracy, ±3% F.S. **Resistance:** Rx1 to Rx1 meg; .068 or 1.5 test volts; 10 ohms center-scale. **Decibels:** 9 ranges from −20 to +60dB; accuracy, ±3% F.S. **Power Required:** One 9V type 2V6 battery and one 1.5V "D" cell. **Size (HWD):** 18 x 14.5 x 9.1 cm (7.25 x 5.82 x 3.63″). **Weight:** 907 g. (2 lbs.) Includes Model PR-21 Probe with 100K isolation resistor. See page 38 for optional PR-28 high-voltage probe.

Solid-State Electronic Multimeter





B&K-PRECISION FET Meter Model

290

Hi-Lo power ohms ranges • 7″ meter with 6⅝″ scale arc • 50 mV full-scale sensitivity • 50 uA current range • R x 0.1 ohm range with 1 ohm center scale.

15 megohms input impedance, all ranges. Fused for protection of meter circuit, FET input. **DC Volts**—10 ranges: 50 mV to 1500 V. Accuracy: ±1.5% F.S. **AC Volts**—10 RMS Ranges: .05-1500 V. 10 P-P ranges: 140 mV to 4400 V. Accuracy, ±3% F.S. @ 60 Hz, except ±5% on 500 V and 1500 V ranges. Response: 7 Hz to 750 kHz. **DC current**—10 ranges: 50 uA to 1.5 A. Accuracy: ±3%, except ±4% on 1.5 A range. **AC Current**—10 Ranges: 50 uA to 1.5 A. Accuracy, ±4% F.S. except ±5% on 50 uA and 1.5 A ranges. **Ohms**—15 Ranges: 8 Lo-Power (R x 0.1 to R x 1M) and 7 Hi-Power (R x 1 to R x 1M). Accuracy, ±3° of arc. **DB**—10 Ranges: −40 to +66 dB. Accuracy, ±3% F.S. Size: 7¼ x 8 x 3⅝″ D.

Vacuum Tube Voltmeter

B&K-PRECISION
Model

177

Internal ohms power supply—no battery needed • 37 ranges, including dB and zero center scales • Includes PR-43 DC/AC/Ohms probe with switch and ground lead • Low AC ranges have special calibrations • 7″ mirrored scale • DC polarity switch • 1% precision resistors in all critical circuits.

DC Volts: 0-.5, 1.5, 5, 15, 50, 150, 500, 1500. **AC Volts:** RMS, 0-1.5, 5, 15, 50, 150, 500, 1500; peak-to-peak, 4, 14, 40, 140, 400, 1400, 4000; frequency response, ±1dB, 40Hz-3MHz (600 ohm source, 5V range). **Resistance:** 0-1K, 10K, 100K; 0-1, 10, 100, 1000 meg; 10 ohms center scale. **Input Resistance:** 11 megs (1 meg in probe). **Accuracy:** DC, ±3% F.S.; AC, ±5% F.S. **Power Required:** 105-125VAC, 50-60Hz. **Size (HWD):** 18 x 18 x 9 cm (7.13 x 7.25 x 3.63″.) **Weight:** 2.24 kg. (6 lbs.). • See page 36 for probes.

Volt-Ohm-Milliammeter

Resettable Electronic
Overload Protection

One of the most accurate, rugged, versatile VOM's ever designed—and it's fully protected by ' electronic overload reset.

Save money on repairs and elimination of lost time due to repairs!

B&K-PRECISION
Model

120P

20,000 ohms/volt DC input impedance for minimum circuit loading. • 2% DC accuracy. • 35 ranges. • Electronic overload protection system, including front panel reset. • Special .25 volt and 50 µA DC ranges. • Precision, taut-band meter movement. • Easy-access fuse and battery compartment.

20,000 Ω/V DC; 5,000 Ω/V AC. **DC Volts**—8 Ranges: .25 to 1000 V, ±2% F.S. **DC Current**—6 Ranges: 50 µA to 10 A (±1.5% F.S. to ±2% F.S.) **AC Volts**—6 Ranges: 2.5 to 1000 V RMS, ±3% F.S. Response: ±1 dB to 100kHz; 250 V AC, ±1 dB to 20 kHz. **AC Output Volts**—4 Ranges: 2.5 to 250 V AC. **Resistance**—3 Ranges: Rx1 to Rx10,000, 2° of arc. **Decibels**—4 Ranges: −20 to +50 db. **Other**—Size: 17.5 x 12.8 x 7.8 cm (5¼ x 7 x 3⅛" D.) With test leads, batteries and manual. **Weight:** 1.2 kg. (2.75 lbs.). **LC 12 Case Optional.**

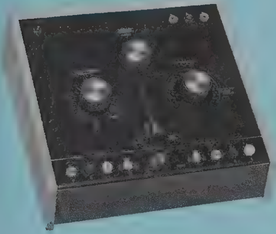
New Lab-Quality Semiconductor Tester

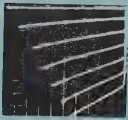
B&K-PRECISION
Model
530

Measures transistor beta or FET Gm • Measures transistor cut-off frequency up to 1500MHz • Nondestructive testing of semiconductor breakdown voltages • Measures I_{CES} and I_{DSS} • Fast testing of transistors, FET's, and SCR's—in or out-of-circuit • No biasing or base information required • Identifies all leads of transistors and SCR's • Automatic identification of PNP/NPN types and N or P channel FET's • Tests all types of transistors, including new power FET's.

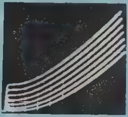
[illegible] **In-Circuit Tests**—Good/Bad Test: For bipolar transistors, FET's and SCR's. **Out-Of-Circuit Tests**—Transistor beta using two collector current ranges (low-power beta 20-600; high-power beta, 20-200). gm of FET's, low-power, .4-12 millimhos; high power, 4-400 millimhos. Ft: Three ranges (0-100MHz, 0-500MHz, 0-1500MHz) BV_{CES}, I_{CES}, PIV of diodes and gate leakage of FET's; I_{DSS} of FET's. Accuracy: Within 10% for β, gm and ft. tests. High-power beta and gm tests: Special 300 μS, 1% duty cycle current pulses enable testing at 2 amps without over-dissipation of device under test. **Indicators**—Audible tone for GOOD indication. LED Lamps identify device polarity. Panel indicator and Test Switch identifies all leads of transistors and SCR's and gate of lead of FET's. Meters indicate other device parameters. **General**—Color-coded Mini-lock clips for hands-free operation; detailed instruction manual. **Optional** FP-5 Dynaflex three-lead, one-hand probe for easy in-circuit testing. **Power:** 105-125VAC, 60Hz, 10 watts. Size (HWD): 17.8 × 33 × 9 cm (7 × 13 × 3½"). **Weight:** 2.3 kg (5 lbs.).

Semiconductor Curve Tracer





Good PNP
Transistor



Leaky NPN
Transistor

B&K-PRECISION Model 501A

[illegible] Display characteristic curves for all semiconductor devices on your scope • Built-in current limiting protects devices under test • Pinpoint bad devices in-circuit • Measure breakdown voltages non-destructively • Identify unknown devices.

[illegible] AC and DC beta ... diode dynamic resistance ... All SCR, diac and triac ... All characteristics including Iceo and Ices leakage ... Switching transistor saturation voltage ... Thermal runaway susceptibility ... FET "on" resistance ... N- and P-channel J-FET and depletion-mode MOSFET'S, including transconductance ... Enhancement-mode MOSFET with external DC bias supply ... Tunnel diodes including average value of negative resistance ... Breakdown voltage with non-destructive test.

[illegible] —**Sweep Generator:** Range: 0-100V peak, 100mA maximum; 120Hz full-wave rectified. Polarity: NPN, PNP. **Step Generator:** 11 Current Ranges: 1μA to 2mA/step, ±3%. 5 Voltage Ranges: .05 to 1V/Step, ±4%. Steps: 6, continuous display. Steps/Sec.: 120. Step Polarity: NPN, PNP. With scope cables, FP-5 three-tip probe, 10 x 10 div. graticule, three-wire line cord. 105-125VAC, 50-60Hz. Size: 10.2 x 25 x 24 cm (4 x 10 x 9½"W.) Weight: 1.35 kg. (3 lbs.).

Dynapeak™ Transistor Tester

B&K-PRECISION Model

520B

Fastest transistor testing • Random lead connection • Works in-circuit when others won't! • Automatic NPN/PNP determination • Automatic Si/Ge identification • Automatic leakage measurement • Audible "beep" indicates GOOD transistor • Now with HI/LO drive.

Tests most devices—from diodes and SCR's to unijunctions and FET's—in-circuit!

In a few seconds, in or out-of-circuit, the 520B lets you determine whether the device is working, whether it is a PNP or NPN type, and which of the three leads is the base (or gate). Collector and emitter (source and drain) leads are also identifiable. Leakage current measurement with acceptable leakage limits displayed for different device types, and silicon or germanium identification can be performed out-of-circuit.

Includes: Color-coded test leads with convenient spring-loaded clips; detailed instruction manual. **Power Required:** 105-125VAC, 50-60Hz; also available for 230VAC, 50/60Hz. **Size (HWD):** 20 x 17 x 8.9 cm (8 x 7 x 3.5"). **Weight:** 2.27 kg. (5 lbs.). **Accessories:** Model FP-5 Dyna-Flex Probe (See Page 39).

Portable Transistor Tester

B&K-PRECISION
Model
510

Fast GO/NO-GO in-circuit testing • Fast and thorough GOOD/BAD out-of-circuit testing • Tests FET's and SCR's in-circuit or out-of-circuit • Connect any test clip to any component lead • Gives positive emitter-base-collector identification in LO drive—positive base identification in HI drive • Light-Emitting Diodes indicate NPN-OK or PNP-OK • Pocket-size—Over 100 hours of testing from single set of "AA" cells • Digital stability—no adjustments; nothing to go out of calibration.

Uses our Dynapeak™ testing technique to test semiconductors even with resistive and capacitive shunt impedances. In LO DRIVE, you get positive GOOD/BAD indication, polarity and identification of all three leads—in-circuit or out-of-circuit! HI DRIVE lets you test devices in-circuit even with low shunt impedances and get positive GOOD/BAD indication, device polarity, and identification of the base lead.

Includes: Color-coded miniature test leads with convenient spring-loaded clips; carrying case; detailed instruction manual.

Power required: 6VDC from four "AA" cells, not supplied. Standby current, 4mA; average testing current, 12 mA. Size (WDH): 9.5 x 16.8 x 4.4 cm. (3.75 x 6.63 x 1.75"). **Weight:** .45 kg. (½ lb.) (less batteries).

Accessories: Model FP-5 DynaFlex Probe (see page 39).

Solid-State RF Signal Generator

The 2050 is a highly versatile, easily portable, accurate RF signal generator.

B&K-PRECISION
Model

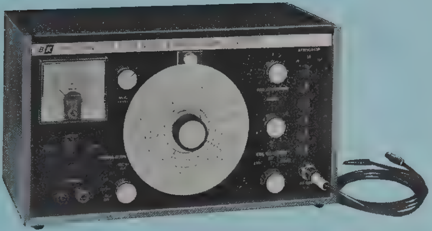
2050

[illegible] RF amplifier gain tests • Signal tracing • School and scientific labs • Hobbyists and experimenters • AM receiver alignment • Signal source for industrial uses, including production lines.

[illegible] 100 kHz to 30 MHz in 6 bands, with 1.5% dial accuracy • 3 outputs: RF, modulated RF and externally modulated RF • Zener-regulated power supply • 100% solid state • Multi-colored, 4½" vernier dial • Weighs only 5 pounds.

[illegible] **Frequency Ranges:** 100–250 kHz, 250–650 kHz, 550 kHz to 1.5 MHz, 1.5–4.0 MHz, 4–11 MHz, 10–30 MHz. All on fundamentals. Accuracy: 1.5% of dial setting. **Output:** 0.1 V RMS or better. **Attenuator:** Combination 20 dB High-Low switch, plus continuously variable output control provides full output range. **Modulation:** 400 Hz; 40%. Size (HWD): 15 x 19 x 24 cm (6.1 x 7.5 x 9.75"). Weight: 2.2 kg. (5 lbs.). With shielded leads and insulated clip/banana plug.

RF Generator



The Model E200D calibrated meter monitors RF level and % modulation with 100% silicon transistor circuitry and zener-regulated power supply.

B&K-PRECISION
Solid-State Model

E200D

Accuracy of better than 0.1% possible with internal crystal calibration. • Wide-range coverage, 100 kHz to 216 MHz in 5 bands. • 100 kHz to 54 MHz on fundamentals and 54 MHz to 216 MHz on harmonics. • Completely shielded RF output. • Continuously variable attenuation from 1 to 106 db. 200 μA D'Arsonval monitor meter.

Range: 100 kHz to 54 MHz on 5 fundamental bands; 54 to 216 MHz on harmonics. Accuracy: ±1.5% of highest freq. of range used. Output: calibrated into 50 Ω load, 100,000 μV max. Output Level Calibration Accuracy ±1 dB of nominal to 54 MHz. Attenuator System: 6 individually shielded step attenuators, capability −96 dB. Modulation: 400 Hz, nominal. Crystal Calibration System: 1 MHz and 100 kHz; 100 kHz output calibrated against 1 MHz crystal oscillator. Accuracy: ±0.05%. Size: 18 x 32 x 20 cm (12¾ x 7¼ x 8″ D). Weight: 4.5 kg. (10 lbs.)

Sine/Square Wave Generator

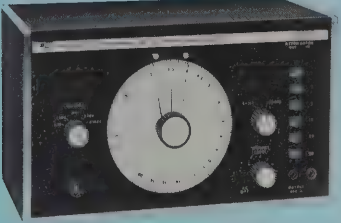
B&K-PRECISION
Solid State Model
3050

Model 3050 features sine and square wave output to 200kHz, high stability, synchronizing input terminal and 10V output

All solid-state circuitry • 0/20/40dB step attenuator plus continuously variable output vernier • Distortion 0.5% max., 50Hz–100kHz; 1% max., 20Hz–200kHz • Low 600-ohm output impedance • Sharp square waves from 20Hz to 200kHz.

Frequency Range: 20–200Hz, 200Hz–2kHz, 2–20kHz, 20–200kHz. **Calibration Accuracy:** ±(3% + 2Hz). **Square Wave Rise Time:** 500nSEC or less. **External Synchronization**—Range: 1½%/V typical. Max. Input: 3VRMS. Input Impedance: Approximately 20,000 ohms. **Effect of ± 10% Line Voltage Changes:** Frequency Drift: Less than ±0.5%. Output Level Variation: Less than ±0.5dB. **Size:** 15 x 19 x 24 cm (6 x 7¾ x 9⅝") deep. **Weight:** 2.8 kg (6.25 lbs.)

Sine/Square Wave Generator



The Model E310B features step attenuation of both sine and square wave outputs—ideal for testing hi-fi systems and speakers.

B&K-PRECISION
Solid-State Model

E310B

All solid-state circuitry. • Fully shielded outputs. • Frequency accuracy of 3% of reading. • Clear sine waves from 20 Hz to 2 MHz with 0.25% distortion. • Completely variable sine wave output of 0 to 8 volts RMS into high-impedance loads. • Sharp square waves from 20 Hz to 300 kHz.

Sine Wave—Range: 20 Hz to 2.0 MHz in 5 ranges. Output: 0 to 8 V RMS into high-impedance loads; 0 to 7 V RMS into 600 Ω. **Square Wave**—Range: 200 Hz to 300 kHz in 4 ranges. Rise-time: Less than 100 n sec at 20 kHz. **Frequency Calibration Accuracy**—±3%, 100 Hz to 2 MHz. **Attenuators**—Step: 56 dB (6 switches), ±5%/600 Ω load. **Other**—Size: 18 x 32 x 20 cm (12¾ x 7¼ x 8″ D). Weight: 4.5 kg (9.5 lbs.)

New PLL CB Signal Generator

B&K-PRECISION Model 2040

Designed for use with all class D CB transceivers... AM and SSB • Covers all 23 channels plus channels for expansion • ±5 parts per million (.0005%) accuracy or better • Delta frequency adjustments allows SSB performance tests • Built-in EIA noise generator to check noise filters and noise blankers • Internal modulation at 400, 1000, and 2500Hz • Calibrated outputs from 100,000 μV to 0.3 μV • Ultra-stable...phase-locked loop circuitry assures stability under all normal operating conditions.

Frequency Coverage and Generation—AM and ΔF: 40 channels, incl. present 23 authorized CB channels. AM and ΔF: Programmable, crystal-controlled phase-locked loop (PLL) and 50-position selector switch; vernier function provides 0-±5kHz channel deviation (ΔF). **Frequency Accuracy and Stability**—AM: Better than ±5 PPM (.0005%). Vernier offset (ΔF) accuracy ±5%. IF: ±.01%, 0-50°C, 455kHz output. **Output Level**—AM and ΔF: 0.3 μV to 100mV, (50-ohm). Output Metering. AM and ΔF: Microvolt and dB. Modulation: AM: 0-100%, calibrated, continuously adjustable. Selectable CW, 400, 1000, 2500Hz or external. ΔF: Simulated single tone SSB modulation. IF: Fixed 30%, ±10%. **Impulse Noise Test**—For receiver noise limiter and blanking tests, an EIA Standard noise test signal generator is provided. **Generator Output Circuit Protection**—Can withstand RF input of 5 watts at 27MHz for 1 minute. **Power:** 105 to 125VAC. **Dimensions:** (HWD) 18 × 27 × 45 cm (7.3 × 10.6 × 17.9"). **Weight:** 7.7 kg. (17 lbs.).

New CB Servicemaster

B&K-PRECISION
Model
1040

Greatly simplified CB transceiver servicing • Checks complete CB transceiver performance in minutes • Checks AM and SSB transceivers • No complex hookups or calculations required • Test results displayed on direct reading meters • Only one hookup required for all tests • When used with a scope having a bandwidth as low as 2MHz, a frequency counter, and a stable calibrated output RF generator, you can measure all important CB rig parameters.

RF Wattmeter—Impedance: 50 ohms. Load: 50-ohm, 50-watt continuous, 100-watt intermittent. Accuracy: ±5%. Metering: Average or peak and SWR. Insertion VSWR: Less than 1.1:1. **Audio Wattmeter**—Impedance: 4, 8 or 16 ohms. 10 watts, continuous. **Distortion Measurement**—Type: THD at 1kHz. Scale: 0-30% direct reading, ±5%. **Audio**—Outputs: Receiver audio. 1kHz test tone. Two-tone test signal. **Scope Output**—Transmit: 1MHz representation of 27MHz carrier for examination of modulation on any low-freq. oscilloscope. **Power**—117VAC, 60Hz: 3 watts. 13.8VDC: 150 milliamperes. Reverse polarity protection. Size (HWD): 10.2 × 34.3 × 27.9 cm (4 × 3.5 × 11"). **Weight:** 2.55 kg (5 lbs.), 10 oz. See Page 37 for instrument connecting cables.

40MHz Autoranging Counter

B&K-PRECISION
Model

1801

Display of 60MHz typical frequency upper limit

Automatic ranging • 1Hz resolution • Six-digit solid-state readout with discrete reliable TTL logic • Suppression of leading digit for extra resolution above 1MHz on 1SEC gate time • 10MHz crystal time base for stability • Three automatic decimal point positions • Accepts wide input range without level adjustment • Gate times automatically selected for best accuracy and fastest reading.

FREQUENCY—Range: 20Hz-40MHz guaranteed; 10Hz to over 60MHz typical. **Auto Gate Time:** 10mSEC or 100mSEC (MHz reading) or 1SEC (kHz reading). **Manual Gate Time:** 1SEC. **Overflow:** Flashing light. **Display Refresh Interval:** Fixed; 200mSEC plus gate interval. **INPUT—Impedance:** 1meg/25pF. **Protection:** Diode. **Coupling:** AC. **Sine Wave Sensitivity:** 30mVRMS (guaranteed); 15mVRMS (typical). Maximum Input: (peak AC + DC): 200V to 500Hz; linearly derated to 100V at 1kHz; 100V, 1kHz-5MHz; linearly derated to 50V at 40MHz. **Setability:** +0.1PPM (±1Hz). Typical Accuracy: Better than ±10PPM. 105-130V, 60Hz, 25W maximum. **Size (HWD):** 3.31 x 8.69 x 10.5″. 105-130V, 60Hz. **Weight:** 5.5 lb.

New Mobile Equipment Power Supply

B&K-PRECISION
Model
1640

Citizens' Band transceivers... Auto tape decks...Auto radios...FM converters... Electronic ignitions.

Regulated adjustable output from 11-15VDC, 0-3A • Fully automatic overload protection, manual reset, 5A surge limit • Perfect for servicing CB radios and all other 12 volt mobile equipment.

Output Voltage: 11-15VDC, continuously variable. Output Current: 0-3A continuous, 5A surge limited. **Meter:** Voltmeter-ammeter, (illuminated). **Overload Indicator:** LED glows after overload. **Ripple:** Less than 7mV RMS; 0-3A. **Load Regulation:** Less than 0.8% voltage change from 0-3A, 11V to 15V. **Line Regulation:** Less than 0.8% voltage change at 3A output ±10% line variation. **Short Circuit Protection:** Shutdown; manual reset. Surge current limited to 5A maximum. **Input Voltage:** 115/230VAC, 60Hz. **Size** (HWD): 7.8 × 25 × 22 cm (3-1/6″ × 10″ × 8½″). **Weight:** 3.6 kg. (8 lbs.).

Regulated Power Supplies

B&K-PRECISION Model **1601**

Advanced-design supplies for schools, service, labs and production feature simplified current limit setting that does not require shorting output terminals. Fail-safe overload protection shuts unit down when current exceeds preset level. Push-button restores operation.

MODEL 1601: 0–50VDC output, continuously variable with single control. • 0–2A, fully regulated. • Standby switch disconnects load. • On/Off/ Voltage Output control assures initial zero output.

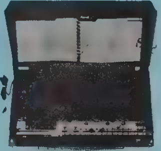
Load Regulation: Maximum, 0.1%; typical, 0.07%. **Line Regulation:** 0.02% typical at max. output ratings, 105–125VAC. Ripple: 5mV p-p max. **Size:** (HWD) 3.9 x 14.1 x 10 cm (3.8 x 14.1 x 10″).

B&K-PRECISION Model **1602**

MODEL 1602: 0-400VDC, 0-200mA continuously variable. • 0-100VDC, 0-2mA continuously variable bias supply. • 12.6/6.3VAC, 3.5A non-adjustable filament outputs with circuit breaker.

Load and Line Regulation: 1% typical. Ripple: Less than 10mV p-p. **Size:** (HWD) 3.9 x 14.1 x 10 cm (3.8 x 14.1 x 10″).

100% Dynamic Gm Tube Tester



B&K-PRECISION Model

747B

Solid-State "Dyna-Jet"

Overload reset on front panel... eliminates need for fuse replacement, saves time, indicates overload condition. • All solid-state for stability and reliability. • 100% mutual conductance. • 21 pre-wired sockets are provided for most common tubes—only 2 settings are required. • 9 programable sockets protect against obsolescence. • Detects leakage as low as 0.5 μA. • Detects shorts up to 1 MΩ. • Tests each tube section separately. • Grid leakage up to 100 MΩ easily detected. • Automatic line voltage compensation. • Tests diodes, rectifiers and high voltage regulators. Size: 13 x 50 x 30 cm (5-5/16 x 20½ x 11½" D). Weight: 5.8 kg. (13 lbs.).

High-Speed Solid-State Tube Tester

Tests the newest tube types—plus all old TV/radio types.

B&K-PRECISION Model

667

"Dyna-Jet"

The only tube tester in its price class to give a positive shorts indication. • Checks tubes accurately under simulated load conditions. • Tests tubes faster; max. number of settings: 4. • Lockout buttons eliminate false short readings. • Provides high-sensitivity grid emission and gas tests. • Tests the newest tube types—plus all old TV/radio types.

In handsome, resilient case. Size: 34 x 25 x 13 cm (10" x 13.5" x 5.25" D). Weight: 2.7 kg. (6 lbs.).

CRT Restorer/Analyzer

WITH HIGH SPEED MULTIPLEX TECHNIQUE

B&K-PRECISION
Model

467

Size:
10″ x 13½″ x 5¼″ thick.

• [illegible] Restores color and B/W picture tubes like new! Uses the most powerful restoration method known with minimal danger to the CRT. You can guarantee it with confidence. • Exclusive multiplex test technique tests all three guns of color CRT's simultaneously under actual operating conditions . . . even CRT's with common G1 and G2 . . . with real dynamic tests • Checks *all* CRT's with identical procedure—including all "in-line" and "one-gun" types • Instant, automatic tracking test at the push of a button • Guaranteed speed, accuracy and reliability from automatic digital circuit techniques • Nothing to look up after the initial setup—no calculations, charts or replugging needed • Test indications are clear enough to be understood by your customers • EXCLUSIVE! Tests focus electrode! Size (HWD): 34 x 25 x 14 cm (10 x 13.5 x 5.25″)

See p. 37 for standard and optional adapters.

Ask your B&K-PRECISION distributor for a detailed brochure

CRT Restorer/Analyzer

SAME POWERFUL RESTORATION METHOD AS 467!

B&K-PRECISION
Model

470

Restores color and B/W picture tubes like new! Uses the most powerful restoration method known with minimal danger to the CRT. You can guarantee it with confidence • Exclusive technique tests guns of color CRT's under actual operating conditions . . . even CRT's with common G1 and G2 . . . with real dynamic tests • Checks *all* CRT's with identical procedure—including all "in-line" and "one-gun" types • Instant, automatic tracking test at the push of a button • Large 5″ meter with multicolor scales for accurate display of tube condition to the customer • Nothing to look up after the initial set-up—no calculations, charts or replugging needed. Size: 34 x 25 x 14 cm (10″ x 13½″ x 5¼″ thick.) Weight: 3.7 kg (10 lbs.)

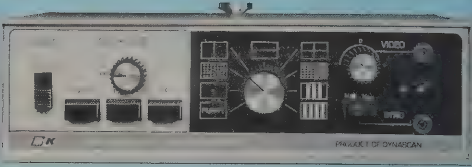
Picture Tube Guarantee

YOU CAN GUARANTEE RESTORATION

In long-term tests of thousands of picture tubes at a major service contractor, B&K-PRECISION has found that more than 95% function as well as new tubes after restoration. That's why we think you can profitably guarantee each restoration for two years with 100% of the restoration fee creditable toward a new CRT during that period. Or offer a three-year extension with 50% toward a new tube.

See p. 37 for standard and optional adapters.

Digital IC Color Generator/Analyst



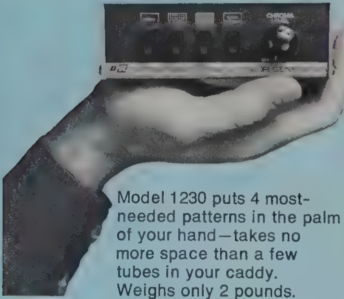
The closest thing to a portable Analyst

B&K-PRECISION
Model
1248

Nine patterns • RF, IF, video, sync and sound outputs • Stable crystal-controlled RF and IF outputs • Switchable horizontal and vertical sync output • Sync level independent of video level control • LSI MOS chip generates all patterns and logic functions • Switchable 4.5MHz sound carrier • Lightweight.

—PATTERNS: Purity, 7 x 11 dots, 7 x 11 crosshatch, crosshair, horizontal line; R-Y, B-Y, —(R-Y); single dot, gated rainbow, vertical line. **LINE WIDTH—Horizontal:** One horizontal Scan line. **Vertical:** Preset to .25μSEC, internally adjustable from .1 to .8μSEC. **COLOR SUBCARRIER:** Adjustable 0 to 200%. **SIGNAL SYNTHESIS**—Progressive scan system derives all sync and video. **SYNC PULSES—Output** ±5V peak horizontal or vertical. **OUTPUT CARRIERS—Frequencies:** Channel 3, channel 4, 45.75MHz IF (all crystal-controlled) and 4.5MHz ±0.2% unmodulated audio, all switch selectable. **VIDEO OUTPUT**—0 to ±1.5V p-p, into 75Ω; amplitude and polarity continuously variable. **Operating Temperature Range:** −25°C to +75°C. 105-130VAC, 60Hz. **Size (HWD):** 2.25 x 7 x 9.38". **Net Weight:** 4 lbs. With cable, carrying case.

Digital IC Color Generator



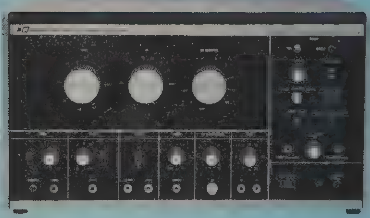
B&K PRECISION
Model
1230

Model 1230 puts 4 most-needed patterns in the palm of your hand—takes no more space than a few tubes in your caddy. Weighs only 2 pounds.

Integrated flip-flop circuits for ultra-stable picture • All video, sync, blanking and color signals derived from a single crystal-controlled 4.751748MHz master oscillator • Broadcast-stable 10,000μV signal—color subcarrier can be expanded and examined on an oscilloscope • User-adjustable to channel 3, 4 or 5

Line Width—Horizontal: One horizontal line. Vertical: Preset to .25μSEC; internally adjustable from .1 to .8μSEC for adjustable dot size and vertical line width. Subcarrier Level: Adjustable 0–200% with front panel control. **RF Output**—10,000μV typical into 300 ohms. Factory tuned to Channel 3; user adjustable to Channel 4 or 5. **Signal Synthesis**—Progressive Scan System: Entire countdown chain synced to 4.751748MHz ±.001% master oscillator using digital logic elements. Patterns: Switch selectable Purity/Dots/Crosshatch/Gated Rainbow. **Mechanical**—Size: 1.73 x 5 x 7.75" deep. Operating Temperature Range: 0–70°C. 105–130VAC, 60 Hz.

Television Analyst



The Model 1077B reduces trouble-shooting time by using signal injection to isolate circuit defects—checks every stage (transistors and tubes) in B&W and color TV sets, from UHF and VHF antenna input to CRT grid. Test pattern produced by flying spot scanner checks circuit quality with results displayed on TV picture tube.

B&K-PRECISION
Model
1077B

[illegible] The 1077B is a combination TV station and TV receiver. • Drives solid-state sweep circuits. • 8 VHF RF channels allow servicing at any location.

[illegible] **Variable Output Signals**—RF: VHF Ch. 2-13, 0-10,000 μV; UHF Ch. 14-83, 0-1000 μV. Video IF: 20 — 48 MHz, 0-70,000 μV. Video: Composite, 0-2.5 V (+ or — polarity). Sync: 0-50 V (+ or — polarity). Sound IF: 4.5 MHz FM with 1 kHz audio tone. Audio: 1 kHz, 1 V. Color: 3.56 MHz XTAL Controlled Rainbow Pattern, 0-5 V. Bias Supply. 0-25 V (+ or — polarity). Horiz. (15,750 Hz) and Vert. (60 Hz) Grid and Plate Drive Signals sufficient to drive tube and transistor output circuits. AGC Keying Pulse: 400 V P-P. Size: 9¾ x 18 x 12″ D. Includes test pattern slides and cables.

Solid State Sweep/ Marker Generator

B&K-PRECISION
Model

415

Simplifies sweep alignment of all television receivers with the absolute accuracy required in color set adjustments.

The most useful test instrument ever devised for TV alignment. • FOUR instruments in one—everything you need except a scope and VTVM. • All markers are individually crystal-controlled and post-injected. • 100 kHz marker system permits aligning automatic fine tuning. • Markers can be viewed in horizontal and vertical positions.

Available Outputs (7)—Video Sweep (0-6 MHz), IF Sweep (35-50 MHz), Unmodulated Markers, Modulated Markers, Channel 4 RF Sweep, Channel 10 RF Sweep, 10.7 MHz Sweep. **Sweep Widths**—RF-IF: 1 MHz to over 10 MHz, 10.7: 100 kHz to 2 MHz. **Output Impedance**—72 Ω, 300 Ω for RF Output to antenna. **IF Markers (10 standard crystal-controlled)**—39.75 MHz to 47.25 MHz. **Separate Bias Supplies (3)**—two each 0-25 V DC reverse polarity, one 0-50 V DC reverse polarity. **Other**—Size: 9 x 17⅝ x 10⅝″ D. 3-wire line cord. With complete accessory package, including probes, connectors, shielded cables, comprehensive instruction manual.

Counter, Alignment Generator, VOM, VTVM and Oscilloscope Accessories

Model	Description	For Model(s)
AV-1A	250MHz RF Probe	175, 177, 375
AV-2A	50kVDC High-Voltage Probe	175, 177, 375
PR-21	Isolation/Direct Probe	1403, 1403A, 277, 280, 281, 282, 290
PR-23	RF Demodulator Probe	1431, 1440, 1460, 1465, 1470, 1801
PR-25	10:1/1:1 Counter Probe	1801
PR-28	40kVDC High-Voltage Probe	277, 280, 281, 282, 283, 290
PR-30	10:1/Direct Probe	1431, 1440, 1460, 1465, 1470
PR-31	10:1/Direct Probe	1461, 1471, 1471B, 1471C
PR-34	10:1/Direct Low-Cap. Probe	1472, 1472B
PR-35	10:1/Direct Low-Cap. Probe	1472C
PR-36	10:1/Direct Low-Cap. Probe	1474
PR-43	AC/DC/Ohms Probe	175, 177, 375
PR-151	RF Demodulator Probe	415
TP-41	Terminated RF Cable	415

TV Analyst, Tube Tester and CRT Tester Accessories

Model No.	Description	Fits Model(s)
ASM-110	Set of 4 Slides	1077
TC-62B	Novar Adapter	600, 606, 607, 666 667
TC-70	Hi-V Rectifier Tube Adapter	600, 606, 666, 700
TC-75	6BK4 Tube Adapter	600, 606, 666, 700, 707
TC-80	Magnoval Tube and Novar Socket Adapter	600, 700, 707

ADAPTERS INCLUDED WITH 467 & 470

Adapter	Description
CR-1	90° in-line RCA; 110° color
CR-2	70° color
CR-3	90° RCA button-base—large Trinitron
CR-4	90° GE in-line button-base and special 90° button adapter
CR-5	Small Trinitron
CR-6	110° B/W RCA button-base

OPTIONAL 467/470 ADAPTERS

Adapter	Description
CR-7	7-pin min. std. B/W
CR-8	7-pin min. special B/W
CR-9	RCA button-base spec. B/W
CR-10	70° duodecal B/W
CR-11	70° Sylvania shell base B/W
AK-670	5 above adapters plus pkg. of 100 restoration guarantees
CR-12	Spec. GE common cath. in-line, including 11SP22 and 11WP22
CR-13	"Quintrix" CRT's
CR-14	Japanese 110° delta CRT's
CR-15	Japanese 90° in-line CRT's
CR-16	Sylvania/GE in-line CRT's

Model No.	Description	Fits Model(s)
SP-65	Adapter converter to use 467/470 adapters	465
SP-66	Adapter converter to use 467/470 adapters	466

INSTRUMENT CONNECTING CABLES

Model CC-41. 36" RG/58U with a BNC connector on each end.

Model CC-42. 36" RG/58U with BNC connector and UHF connector (PL-259).

Model CC-43. 36" RG/58U with BNC connector and banana plugs.

Model CC-44. 36" RG/58U with BNC connector and coaxial microphone connector.

Model CC-45. 36" RG/58U with BNC connector and type N connector.

Model CC-46. 36" RG/58U with UHF connector (PL-259) on each end.

Model CC-47. 36" zip card with spade lugs and cigarette lighter plug.

Model CC-48. 36" audio coax with ¼" phone plug and dual banana plug.

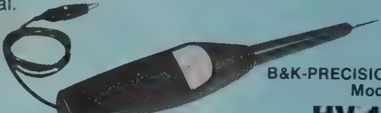
Model CC-49. 36" audio coax with phono plug to dual banana plugs.

Model CC-50. 36" audio coax with 3.5 mm mini-phone plug to dual banana plug.

High-Voltage Direct Reading 40kVDC Probes

B&K-PRECISION
Model
HV-44

Extreme reliability and user safety • Voltage measurements up to 40,000 volts • Calibrated at 25kV and should never need recalibration • Accuracy at 25kV is ±2% and ±3% at full scale • Meter is unaffected by common outside magnet fields and is highly shock resistant. LC-32 Case optional.



B&K-PRECISION
Model
HV-40

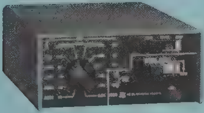
Completely self-contained unit • Direct reading from 0 to 40kV • Core magnet-type meter is free from outside magnetic influence • Lightweight yet rugged • Built-in overload capability • Tracking Accuracy: ±2% of F.S. Reading Accuracy: 2% at 25kV. LC-32 Case optional.

High-Voltage Multiplier Probe

B&K-PRECISION
Model
PR-28

Extends the voltage ranges of any high-impedance voltmeter to 40,000 volts • Can be used with Models 277, 280, 282, 283, 290, or with any constant-impedance voltmeter (10 megohm input or greater) • Safe one-hand testing • Freq. Range: DC-80Hz; 20kVAC max. at 60Hz. Impedance: 600 megohms nominal • Accuracy: 2% at 25kV. LC-32 Case optional.

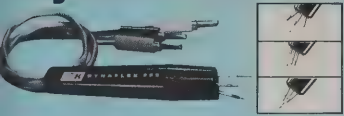
Substitution Box with Surge Protection



B&K-PRECISION
Model
2901

36 components • 24 carbon resistors; 12 1W, 12 ½W • 9 disc/tubular capacitors • 3 electrolytics • Size: 2 × 4¼ × 4″ deep • Automatically introduces a resistor in series with the sub unit to limit charging surge, preventing inadvertent "healing" of defective electrolytics which masks the problem.

Dyna-Flex Probe

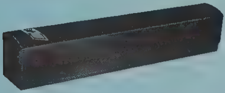


B&K-PRECISION
Model
FP-5

The Model FP-5 provides fast, one-handed, in-circuit testing.

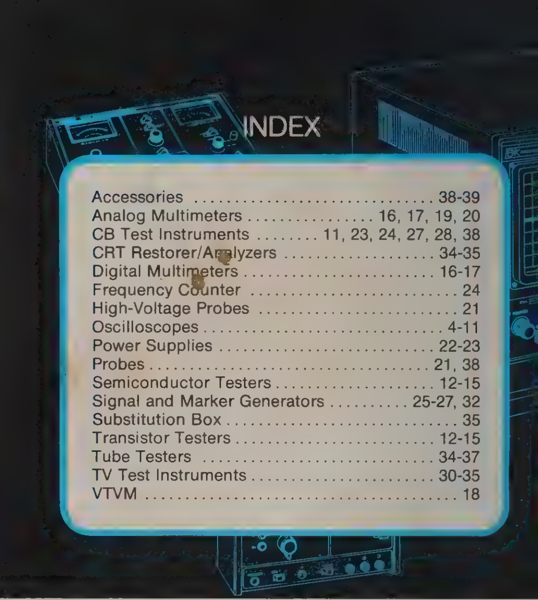
Positive contact only • Color-coded, spring-loaded tips of the 3 probes are needle-sharp to pierce terminal solder • Adjust to any spacing, 1/32″ to 5/8″, using only one hand • Permits rapid access to dense, miniaturized circuits. Use with any transistor tester, VTVM, VOM, or FET Meter.

Carrying Case



B&K-PRECISION
Model
LC-32

Optional vinyl case for PR-28, HV-40 or HV-44.



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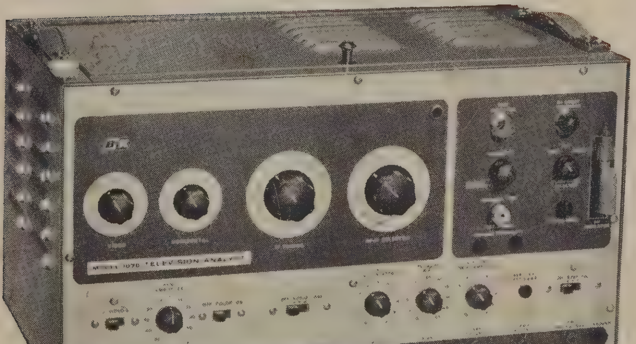
B+K PRECISION
6460 W. CORTLAND AVENUE
CHICAGO, ILLINOIS 60635
Phone (312) 889-9087

TELEVISION ANALYST

Model 1076

B&K

INSTRUCTION MANUAL



B & K MANUFACTURING COMPANY
DIVISION OF DYNASCAN CORPORATION
1801 W. BELLE PLAINE AVENUE, CHICAGO 13, ILLINOIS

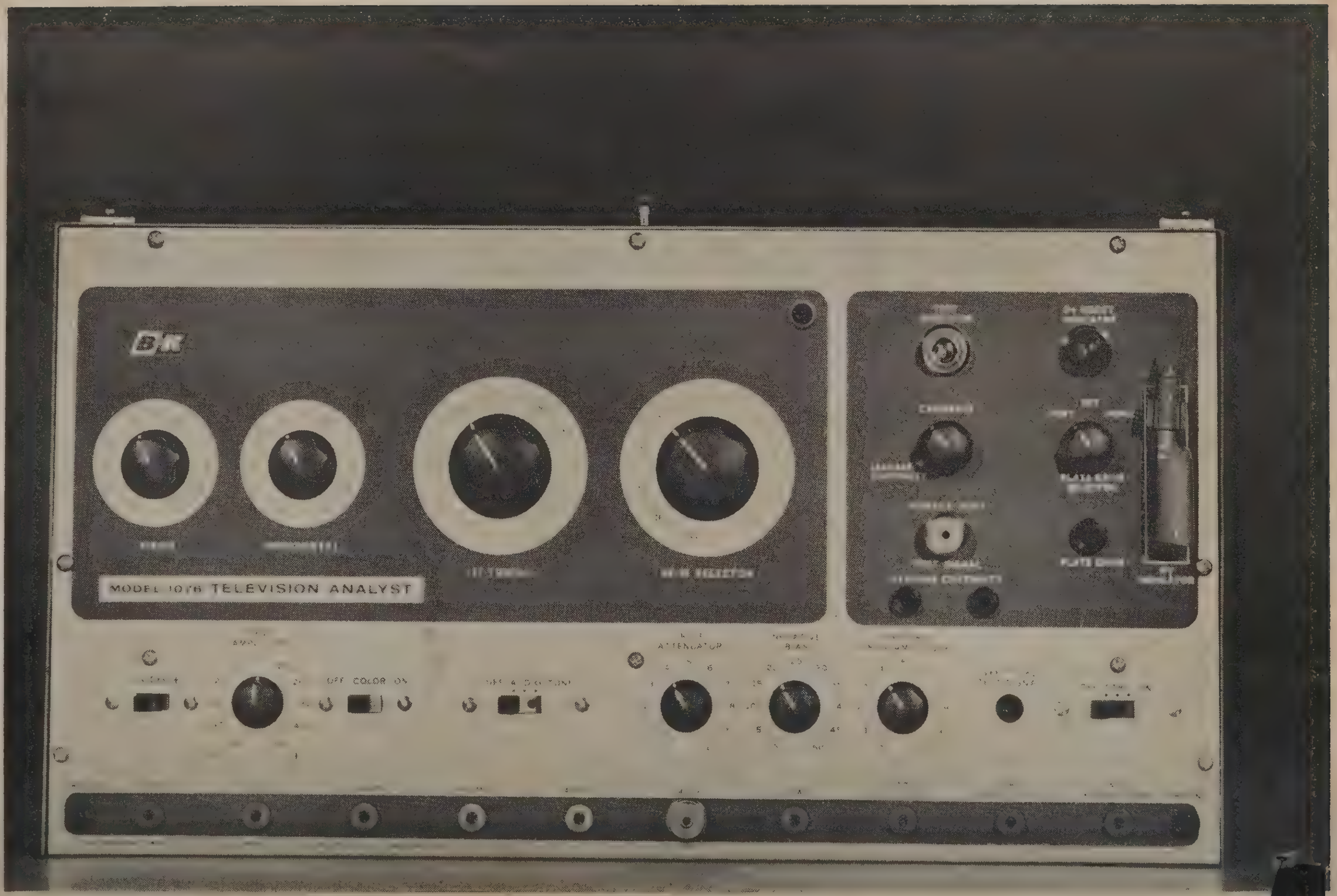


Figure 1. — Front Panel Controls

INSTRUCTION MANUAL

FOR

Model 1076

TELEVISION ANALYST

B & K MANUFACTURING COMPANY
DIVISION OF DYNASCAN CORPORATION
1801 West Belle Plaine Avenue
Chicago 13, Illinois

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MODEL 1076 TELEVISION ANALYST

What The Model 1076 Television Analyst Will Do:

Some idea of the versatility of the Model 1076 Television Analyst can be gained from a quick check of the following list of major equipment features and uses.

1. As a signal generating source for point-to-point signal injection trouble shooting techniques throughout a complete TV receiver.
2. Will supply complete (video and audio) R.F. and I.F. signals to quickly trouble shoot these sections of TV receivers.
3. Will supply a complete test pattern at video (either sync positive or negative) to inject signal into video stages of TV receivers.
4. Provides a 4.5 mc sound channel, F.M. modulated with approximately 25 KC deviation. This audio carrier is modulated from either a built-in 400 cycle tone generator, or any external audio source.
5. Provides a 400 cycle audio tone signal for signal injection.
6. Separate vertical and horizontal driving pulses are available for injecting for trouble shooting sweep circuits.
7. Provides composite synchronizing signals either sync negative or sync positive, adjustable in amplitude, to troubleshoot sync circuits.
8. Provides vertical output stage plate drive signal to check vertical output transformer, and yoke.
9. Provides vertical yoke test signal to determine if vertical yoke windings are defective.
10. Provides horizontal driving signal to drive horizontal output transformer directly in a TV receiver.
11. Provides B+ boost indicator.
12. Provides hi-voltage indicator.
13. Provides sensitive leakage and continuity test for horizontal output transformer and yoke.
14. Provides sensitive test to determine if horizontal output transformer or yoke have internal shorted turns.
15. Provides a high level A.G.C. keying pulse for substitution in keyed A.G.C. systems.
16. Provides high level test signal to directly modulate TV picture tubes.
17. Built in calibrated low impedance negative bias supply.
18. As a white dot and cross-hatch generator for color TV convergence adjustments.
19. To trouble shoot and signal trace color circuits in a color TV receiver. Generates color rainbow pattern and color bar pattern.
20. By the use of the test pattern, TV receivers can be checked for bandwidth, resolution, shading and contrast capabilities.
21. Checks the R.F. sensitivity and A.G.C. settings of TV receivers.
22. To check and adjust the vertical and horizontal linearity, size and aspect ratio of TV receivers.
23. As a stable signal source for trouble shooting intermittents.
24. Will reproduce any 3″ x 4″ positive transparency as a picture source to demonstrate the performance capabilities of TV receivers.
25. As an advertising medium to display both picture and sound messages on the screens of TV receivers in department and retail stores.
26. As the transmitter for video and audio paging systems at conventions, hospitals and other gatherings.
27. To check performance of community and master antenna systems.

CONTROLS: WHAT THEY DO

Main Controls

The following main operating controls are provided on the front panel of the Model 1076 Television Analyst. (See Figure 1).

1. POWER SWITCH. This Switch is labeled Off-Stby-On, and permits the unit to be kept at readiness by using the Stand-by position to keep the tubes hot, yet prevents any radiation of signal from the unit. The pilot light will light in either the "Stby" or "On" position.
2. R.F. - I.F. SELECTOR SWITCH. By means of this Switch the Television Analyst can be tuned to channels 2 through 6, 7, 8, 12 or 13. When switched to the I.F. position the unit will transmit on I.F. Both R.F. and I.F. frequency generators are turned off in the "Off" position of the R.F. Selector Switch.
3. I.F. TUNING. This control enables the Television Analyst to tune any I.F. frequency between 20 mc and 48 mc.
4. VIDEO CONTROL. This Control is used to determine the amount of Video or contrast of the picture.
5. HORIZONTAL CONTROL. This Control is a fine frequency adjustment of the horizontal oscillator circuit in the Analyst.
6. VIDEO POLARITY (+ or –) SWITCH. This Switch determines whether the Video output signal will be of a positive or negative polarity. The positive polarity indicates positive going sync pulses; negative polarity indicates negative going sync pulses.
7. SYNC AMPLITUDE CONTROL. This Control adjusts the amplitude and phase of the sync signal available from the Sync Output jack. This control is calibrated in peak to peak volts for both sync positive and sync negative. Clockwise rotation results in positive sync. Counter-clockwise rotation results in negative sync.
8. COLOR OFF-ON SWITCH. This Switch is used to turn on the color signal for a color rainbow or color bar display.
9. AUDIO SWITCH. The Audio Switch is labeled "Off-Audio-Tone". In the "Off" position there is no audio signal being transmitted. In the "Audio" position, any external source of audio can be used to modulate the audio carrier. This source can be anything from .01 to 5 volts such as a microphone, F.M. tuner, record player, tape recorder, etc. The "Tone" position of this switch turns on an internal 400 cycle audio oscillator which is used to modulate the F.M. carrier. This tone can also be obtained at the 400 cycle output jack.
10. R.F. ATTENUATOR. The R.F. Attenuator Control determines the amount of signal output of both R.F. and I.F. frequencies. At R.F. this control should normally be set at mid-range.
11. NEGATIVE BIAS CONTROL. This calibrated Control enables the operator to select a negative voltage to ground, between 0 and 50 volts.
12. VERTICAL DRIVE AMPLITUDE. This Control adjusts the amplitude of both the vertical grid drive signal and the vertical plate drive signal.
13. PLATE DRIVE SELECTOR. This three position Switch provides a choice of a Vertical plate drive signal or a Horizontal plate drive signal to directly drive a horizontal output transformer. The third position is Off. When not using plate drive, this Switch should be in "Off" position, or tearing in the picture might occur.

14. CALIBRATE CONTROL. Calibrates the shorted turns tester and when rotated fully counter-clockwise to the "Leakage-Continuity" position calibrates the instrument for the leakage test on flybacks and yokes. If the Calibrate control is rotated clockwise the test indicator lamp will glow. To turn the lamp off, rotate the calibrate control to the Leakage Continuity position.

Output Jacks and Indicators

When not using a particular Drive Signal disconnect the Test Lead from the Jack, as interference will occur.

1. VIDEO OUTPUT. The signal at video frequencies is taken from the Video Output Jack. The polarity of the signal is controlled by the Video polarity (+ or –) switch. A separate lead is used for a ground return for this signal and for the following output signals. (Do not feed Video Signal to a point with voltage of more than 350 volts).
2. SYNC OUTPUT. High level composite sync signal is taken from this jack. Amplitude and phase are selected by the Sync Amplitude control.
3. COLOR. Color subcarrier (3.58 mc) output is taken from this jack for injection into chroma circuits.
4. 400 CYCLE. The 400 Cycle Tone signal from the audio oscillator is available from this jack at a fixed output level.
5. 4.5 MC. A 4.5 mc signal for sound system trouble shooting is available from this jack. Modulation is optional and is selected by the audio selector switch.
6. R.F. - I.F. OUTPUT. Output signal at the R.F. and I.F. frequencies are taken from this jack.
7. BIAS. The adjustable negative bias between 0 and 50 volts is available at this jack.
8. VERTICAL GRID DRIVE. Vertical Grid Driving Pulses are available from this jack to feed into the TV receiver being serviced. The amplitude of these pulses is controlled by the Vertical Drive Amplitude Control.
9. HORIZONTAL GRID DRIVE. Horizontal Grid Driving Pulses are available from this jack to feed into the TV receiver being serviced.
10. VERTICAL YOKE TEST SIGNAL. This jack provides a low impedance test signal to ground to directly drive the vertical winding of a deflection yoke.
11. A.G.C. KEYING PULSE. A high level positive going A.G.C. Pulse for use in keyed A.G.C. receiver circuits.
12. LEAKAGE-CONTINUITY. The Leakage Test for flyback transformers and deflection yokes is made between these two jacks. This test can be used to measure leakage of any component where sensitivities as high as 10 megohm is required.
13. FLYBACK YOKE TEST SIGNAL. Provides the necessary test signal to determine the presence of shorted turns in a flyback transformer or horizontal yoke winding.
14. TEST INDICATOR. This Indicator is used when making a shorted turns test on a flyback transformer or yoke. It is also used as the leakage indicator for the Leakage-Continuity Test.
15. PLATE DRIVE. The Plate Drive signal for either the vertical or horizontal system is available from this jack. The plate drive selector switch position determines whether it is horizontal or vertical drive.

16. B+ BOOST INDICATOR. This indicates the presence of B+ Boost in the receiver under test when plate drive from the Television Analyst is used.
17. HI VOLTAGE INDICATOR. Indicates the presence of Hi Voltage R.F. to the hi voltage rectifier plate.
18. PILOT LIGHT. Indicates that the Television Analyst is either "On" or in the "Stand-by" position.

Auxiliary Controls

In addition to the main controls on the front panel of the Television Analyst there are auxiliary controls located inside the instrument or on the rear of the chassis. The inside controls are accessible by raising the cover of the Analyst. The location of these controls are shown in Fig. 2. A duplicate of Figure 2 is located inside of the cover of the Analyst.

1. AUDIO GAIN CONTROL. (Rear of chassis). This Audio Gain Control is used to control the amount of input signal to the audio modulator when using an external audio source. This control has no effect when using the 400 cycle tone. The Off-Audio-Tone Switch must be in the audio position.

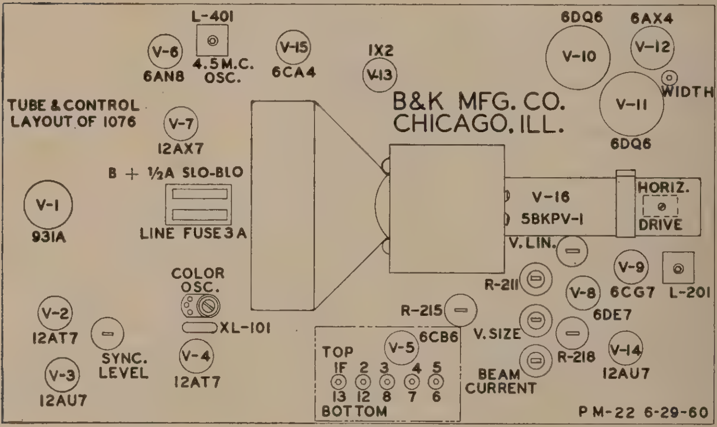


Figure 2
Layout of tubes and controls of the Analyst

2. AUDIO INPUT JACK. (Rear of chassis). External audio such as a signal from an F.M. tuner, Tape Recorder, Microphone etc. can be fed into this jack to modulate the F.M. oscillator.
3. SYNC LEVEL CONTROL. (R-121). This control sets the level of sync signal present in the composite video signal.
4. COLOR OSCILLATOR TRIMMER. (C-114). This capacitor trims the frequency of the color oscillator to the precise frequency required.
5. 4.5 MC OSCILLATOR ADJUST. (L401). This coil adjustment sets the frequency of the internal 4.5 mc F.M. oscillator.
6. WIDTH (L-2 located on the chassis between V-11 and V-12). This width coil controls the width of the horizontal scan on the 5BKPV1 scanning tube. Increasing the scan on 5BKPV-1 scanning tube reduces the size of the reproduced picture on the Television Receiver.

7. HORIZONTAL DRIVE. (C-219). This capacitor controls the horizontal drive to the horizontal output tube. Adjustment of this control establishes the operating conditions for the horizontal output tube and is effective in adjusting the horizontal linearity.
8. L-201 (Horizontal Oscillator Stabilizing coil). This coil assists in stabilizing the Horizontal oscillator frequency and is slug tuned.
9. V. SIZE. (R-207). This control adjusts the size of the scanning raster.
10. V. LINEARITY. (R-206). This control adjusts the vertical linearity of the scanning raster.
11. R-211. This is the coarse Horizontal Frequency Control and is adjusted to permit the front panel Horizontal Control to be centered in its range.
12. BEAM CURRENT. (R-221). This control adjusts the beam current of the 5BKPV1 scanning tube.
13. The centering magnets are located to the rear of the deflection yoke and control the centering of the scanning raster and therefore the centering of the reproduced picture.
14. The R. F. channel adjustments and the I.F. adjustments are slug tuned coils accessible through the holes in the shield of the R.F. assembly. The I.F. slug and channels 2, 3, 4 and 5 are the top slugs while the bottom slugs cover channels 6, 7, 8, 12 and 13.
15. R-218. This control adjusts the sensitivity of the Leakage-Continuity Test.
16. R-215. This control adjusts the voltage to the cathode of V-3A to calibrate the Sync Amplitude control on the front panel.

HOW TO SET UP THE TELEVISION ANALYST

The Television Analyst is an economical equivalent to a standard television field. Therefore, it follows that the operation and adjustments of this instrument are entirely different from the average test instrument found in the TV service field today. The adjustments which will be covered in these instructions in detail are quite simple. FAILURE to make these few adjustments may result in extremely poor performance of the equipment. IT IS, THEREFORE, MANDATORY THAT THESE ADJUSTMENTS BE MADE FOR PROPER OPERATION OF THE TELEVISION ANALYST.

The Television Analyst is an economical equivalent to a standard television station. Just as it is necessary for broadcast personnel to initially and periodically check and adjust their equipment, so too it is imperative that the same type of procedure be used with the Analyst. A decent respect for the tolerance of this equipment should be acquired by the owner so that he may understand its features, advantages and limitations.

The adjustments that are made at the factory are not necessarily the adjustments that will satisfy the conditions in your area. Not all broadcast stations throughout the country produce a test pattern that is identical in setup. It is necessary to make adjustments on the Television Analyst to set it for linearity, size and centering to match your local conditions. These adjustments are made in the following manner:

1. All areas have available at some time during the week a standard test pattern from a local TV station. We take advantage of this to setup to local conditions. Find out when this pattern is available, and allow the Analyst and a standard TV set to warm up for 5 to 10 minutes before using.

2. Tune in the station test pattern on the receiver. Find the mechanical center of receiver screen and adjust set so center of station pattern coincides with this point. Adjust receiver for good linearity, size and centering. Switch on and off the station several times to be sure the horizontal circuit of the receiver is not set at a critical point.
3. With a marking crayon or grease pencil draw circles on receiver front glass representing the circles of test patttern. The exact center of the test pattern is also marked on the face of the monitor.
4. Connect the Television Analyst R.F. output cable to the antenna terminals of the receiver along with an outside antenna.
5. Tune the TV receiver to a local channel and tune the Television Analyst to the same channel. Reduce the R.F. attenuator of the Television Analyst so that both pictures are superimposed on the receiver. It is sometimes more convenient to obtain this display with the Television Analyst on an adjacent channel.

The purpose of this adjustment is to compare the Analyst horizontal frequency to the station horizontal frequency. By adjusting the instrument Horizontal Control it is possible to have the Analyst signal slant to the left, to the right, or stand straight up, as it slides by. Adjust the Horizontal Control station picture. This puts the instrument exactly at station horizontal frequency. For reference, log the number on the panel to which the horizontal knob is pointing when instrument horizontal frequency is the same as the station frequency.

6. Tune the TV receiver to an unused channel in your area and the Television Analyst to the same channel. Adjust fine tuning on the receiver if necessary for best resolution. Adjust Television Analyst controls, Vertical Size and Linearity, Horizontal Size and Horizontal Drive, and centering so that the Television Analyst test pattern is superimposed over the circle drawn on the face of the monitor receiver. All linearity, size and centering adjustments are available by raising the hinged cover on the Television Analyst. Closing the cover will cause a very slight shift in the centering. Make your adjustments to compensate for this.

When these adjustments have been completed, you will then have matched your Television Analyst to the specific requirements of your area.

The long term stability of the Television Analyst is excellent. However, the factory recommends that all adjustments be checked periodically and that the face of the scanning tube be cleaned occasionally.

Where size, linearity and centering of a test pattern obtained from a local TV station is not the average of the most commonly viewed stations, it will be necessary for the technician to set his monitor receiver for a pattern size and centering that he knows from experience will provide viewer satisfaction when the set is in normal use.

This completes the adjustments necessary, and you may now use the Television Analyst for setup of TV receivers for linearity, size and centering, etc., with complete confidence that all receivers set up will meet YOUR local conditions.

OPERATION OF THE TELEVISION ANALYST

In order to become familiar with the operation of the Television Analyst it is suggested that you set up, on a bench, an operating TV receiver. In this way you will become familiar with the procedure and with the available signals and their uses. Assume that you have an operating TV receiver before you and a B & K Television Analyst. The Television Analyst must first be set up as per instructions on page 7.

1. Plug the Television Analyst into a 117 volt, 60 cycle, single-phase A.C. power outlet. Turn power switch to "Stand-by" position.
2. Connect one end of the R.F. test cable to the R.F. OUTPUT JACK on the front panel. Connect the other end of this cable to the antenna terminals on the receiver.
3. Lift cover of analyst and insert test pattern slide into slide track. Push slide all the way. See figure 3. The glossy side of slides should always be towards the face of the scanning tube.

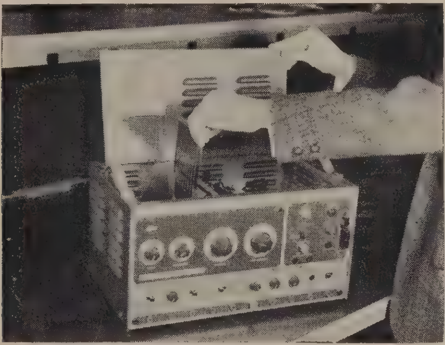


Figure 3—Inserting slide in TV Analyst

4. Turn the Television Analyst power switch to "ON".
5. Set the Channel Selector of the TV set at an unused channel, preferably Channel 6 or below. Set Analyst Channel Selector to the same channel.
6. Set the R.F. ATTENUATOR to number 5. Adjust fine tuning of monitor TV, if necessary.
7. Set brightness and contrast of monitor TV receiver at normal position. Advance VIDEO CONTROL for picture of good contrast. Adjust the VIDEO CONTROL so that the full range of grays near the center of the pattern is visible. If the VIDEO CONTROL is set too high, the picture will tend to overload and distort.
8. The HORIZONTAL CONTROL is adjusted in the following manner. Hook TV antenna and R.F. leads from Analyst to the antenna terminals of the monitor receiver. Tune monitor TV receiver to an On-the-Air TV station signal. Select the same channel on the Television Analyst, and a setting of the R.F. Attenuator, that will permit both pictures to be seen on the receiver. Adjacent channel

operation may be necessary to accomplish this. (For example Channel 3 & 4). Allow the monitor receiver to sync to the On-the-Air signal and observe the Analyst signal floating by horizontally. Adjust the HORIZONTAL control so that the Test Pattern picture stands straight up and barely floats by the TV station picture. This puts the instrument exactly at station horizontal frequency.

9. Set the AUDIO SWITCH to the "Tone" position. This will turn on the sound channel with a 400 cycle audio tone as the modulation. You will now be receiving a complete TV test pattern and an audio tone signal which is being generated by the Television Analyst and going completely through the monitor receiver.

In order to get the "feel" of the front panel controls, we will now adjust some of these controls to see the effect on the picture in the monitor.

Notice that adjusting the Video Control will change the contrast or black to white ratio of the received test pattern. The correct setting for this control is such that the picture shows the full range of greys. If this control is set too high, the picture will tend to overload and distort. Slides or photographs which have greater or less density than the test pattern slide will require a different setting of this Video Control for proper contrast.

Th R.F. Attenuator Control will allow maximum output signal when turned to the maximum clockwise position. As the R.F. Attenuator is turned down the output signal is gradually decreased until it falls to zero output. Zero output does not occur at the point marked zero on the R.F.-I.F. Attenuator but will occur at some point above it. Just before the output falls to zero an unstable condition is reached due to the extremely low level of the signal being transmitted. This unstable condition occurs at a level too low to be useful and can be ignored.

10. Turn the Audio Switch to external Audio position and inject audio signal from an external source into the External Audio Input Jack on the rear of the chassis. This signal volume can be controlled with the Audio Gain Control, also on the rear of the Television Analyst. Now, instead of a tone, the audio signal being received at the monitor TV receiver will be the audio signal being injected into the audio input jack of the Analyst. The built-in audio amplifier will accept signals from .01 to 5 volts, either low or high impedance. The volume control provides a means for adjusting levels to prevent over modulating the R.F. carrier. The 4.5 mc audio channel oscillator is accurately controlled even under varying line voltage conditions to stay within allowable frequency drift limits. The sound channel is frequency modulated with approximately 25 KC deviation at a frequency 4.5 mc above the video carrier.

After the user has become familiar with the operation of the main controls on the Television Analyst, he can proceed to learn to use the other signals available from the unit. (WHENEVER TESTING A TRANSFORMERLESS TV SET, USE AN ISOLATING 1 : 1 TRANSFORMER FOR SAFETY.)

11. Connect the R.F.-I.F. output cable to the grid of the first I.F. amplifier of the monitor TV receiver (making sure ground end goes to ground).
12. Select the I.F. position of the R.F.-I.F. Selector Switch.
13. Tune the I.F. Tuning Control to the correct I.F. frequency for the particular model receiver you are using as a monitor. The I.F. frequencies of the receivers being manufactured today and those produced within the last few years are mainly in the 45 mc region. There are, however, many sets in operation which still use the 25

mc I.F. frequencies. You will notice that when you tune to the correct I.F. frequency you will again see the test pattern and hear the tone on the monitor receiver. Tune for best picture and sound.

14. Move the R.F.-I.F. output cable from the first I.F. to the grid and plate of the second I.F. and then to the grid and plate of the third I.F. tubes and notice how the reproduced video signal on the monitor screen becomes weaker and weaker. This is an effective way of determining whether an I.F. stage is contributing gain to the overall I.F. amplifier system. Notice that with only one I.F. stage, the last I.F. stage, being used there is still enough gain to reproduce the complete test pattern on the monitor receiver. In going through the I.F. stages, it must be noted that the R.F. Attenuator Control also controls the output level of the I.F. signals from the Television Analyst. Turn the audio selector switch to "Off" and remove the R.F. cable from the monitor receiver.

15. Using the test leads provided, connect the Ground Jack on the Analyst to the chassis ground or B— of the monitor receiver. Connect the Video output jack of the Analyst to the video detector load resistor of the receiver. This load can usually be found very easily by looking for the peaking coils associated with this video detector circuit. You will now see the complete test pattern once again, if the video signal is of the right polarity. If the picture is negative, reverse the polarity of the Video Polarity (+ or —) switch. If there is more than one video amplifier stage in the monitor receiver, the signal can be injected into the grid of the second video amplifier and the test pattern can again be reproduced. It will be necessary to reverse the polarity of the video polarity switch because the polarity of the signal is reversed in going through each amplifier stage. Remove the video output cable from the monitor receiver.

16. Connect the ground jack on the Television Analyst to the chassis ground, or B— of the monitor receiver. Connect a second test lead to the sync jack of the Television Analyst and inject this signal to the grid or cathode of the picture tube of the monitor receiver. Select the element which receives video modulation. Rotate the amplitude control to +50 volts and observe black and white bars running out of sync on the monitor receiver. Rotate the sync amplitude control to the —50 volt position, notice that the phase of the modulation on the monitor receiver changes. This signal is used to determine whether or not a picture tube will accept video modulation. Restore receiver to normal operation.

17. Turn the Audio Switch to "Tone" position and connect the appropriate test leads from the 4.5 mc Audio I.F. Output jack of the Analyst to the grid of the first audio I.F. (4.5 mc) amplifier. You will now hear the audio signal in the sound system of the TV receiver. Move this signal to the grid of the video amplifier and the tone will still be heard. To verify this signal, turn the Audio Switch to the "Off" position and see if the sound in the monitor speaker disappears.

18. Connect a ground lead of the Television Analyst to ground, or B— on the monitor receiver. Remove a sync amplifier tube from the monitor receiver. If this is a series string set, short out the heater pins in the socket of the tube just removed. This permits the remainder of the receiver to operate normally. Connect a second test lead to the Sync jack of the Analyst. Inject this signal to the plate of the socket of the tube just removed. Rotate the sync amplitude control to +50 volts. If this sync signal is of the proper phase, the picture on the monitor receiver will be properly in sync. If the

picture is not in sync, rotate sync amplitude control to the opposite phase, or —50 volts. This illustrates how the sync signal is used.

19. Plug the test lead into the 400 cycle Audio Tone jack and connect the other end of the cable to the grid of the first audio amplifier tube. With the Audio Switch in the "Tone" position, the 400 cycle signal will be heard in the TV monitor loudspeaker. (NOTE:—The Audio Gain Control of the Television Analyst does not control the gain of this tone signal). Move the test signal lead to the grid of the audio output tube. The tone again will be heard in the receiver speaker.

20. Remove the audio signal lead from the monitor receiver and connect the cable from the Vertical Grid Drive jack on the Analyst to the grid of the vertical output amplifier tube of the monitor receiver. Remove the vertical oscillator of the monitor receiver. If it cannot be removed because it is a dual purpose tube, or a series heater set, disable the oscillator circuit. Notice that the pulse from the Analyst will operate the vertical amplifier and produce a vertical sweep on the TV monitor receiver. The magnitude of the vertical sweep can be controlled by the Vertical Drive Amplitude control. This sweep may not be linear, or it may not fill the complete vertical size of the picture tube because the pulse may not be matched to this particular vertical output circuit. However, it can very nicely and qualitatively determine whether the vertical amplifier circuit is operating correctly.

21. Remove the vertical pulse lead from the monitor and the Television Analyst. Connect the lead from the Horizontal Grid Drive Pulse output jack on the Analyst to the grid of the horizontal output tube (6BG6-6BQ6). Disable the TV set horizontal oscillator, or remove it from its socket. Note: Do not turn the TV set on without any horizontal driving pulse to the horizontal output tube (either from the Analyst or the horizontal oscillator of set. Without driving pulses to the horizontal output tube, the tube will burn up).

    You will notice that the horizontal output of the monitor receiver has a complete horizontal sweep and provides high voltage through the high voltage rectifier, of the receiver. This will provide a quick check to determine whether the fault is with the oscillator circuit or the output circuit in trouble shooting horizontal circuits.

22. Remove the Horizontal Grid Driving lead. Connect a test lead from the Plate Drive Jack on the Television Analyst to the plate cap connector of the flyback transformer (the horizontal output tube plate cap) of the test receiver. We are actually replacing the horizontal section, including the output tube of the receiver with the horizontal section and output tube in the Analyst. Put the Plate Drive Selector switch on the Television Analyst to the Horizontal position. Turn on the test receiver. The test receiver will now have full Horizontal scan and high voltage. The Television Analyst is providing complete drive for the horizontal output transformer of the test receiver. The B+ Boost indicator on the Television Analyst will also light indicating that B+ Boost is present in the test receiver.

23. Remove the horizontal plate drive lead from the plate cap of the flyback, and restore set to original condition. Now connect plate drive lead to the plate pin of the vertical output tube of the test receiver. Remove the vertical output tube of the test receiver. Put the Plate Drive Selector switch of the Television Analyst to the Vertical position. Apply power to the test receiver. Vertical scan will now result. The size of the scan on the test receiver can be adjusted by means of the Vertical Drive Amplitude control on the front of

the Television Analyst. The scan will not necessarily be linear but provides an excellent test on the vertical output transformer and yoke. Disconnect the Plate Drive test lead and reinsert the vertical output tube in the test receiver. Turn the Plate Drive Selector switch to the "OFF" position.

24. Disconnect the leads of the vertical winding of the deflection yoke of the test receiver. Connect one lead to ground on the Analyst and the other lead to the Vertical Yoke Test Signal jack on the Television Analyst. Turn on the test receiver. Vertical Scan will be seen on the test receiver. While not linear in deflection it proves that the vertical yoke will provide deflection. Remove test leads and reconnect vertical yoke leads to the test receiver.
25. To test a transformer for shorted turns connect the shielded cable to the Flyback-Yoke test signal jack. Adjust the Calibrate control until the test indicator lamp just goes out. Connect the flyback transformer to this cable. The connection is made from horizontal output plate cap connector to hi voltage rectifier plate cap connector. If the test indicator glows this indicates that the transformer has shorted turns. This test will respond to as little as one shorted turn. If the component to be tested is the horizontal winding of the deflection yoke, connection is made across the deflection yoke winding. It is also important to test the yoke for leakage between the vertical and horizontal winding and from the horizontal to the metal frame of the yoke. Do not use the yoke test on the vertical winding, as erroneous results will be obtained.
26. To observe the action of the Negative Bias Supply, connect the Television Analyst to obtain a picture on the test receiver. Connect a ground lead from the Television Analyst to the test receiver and connect a test lead from the Negative Bias supply output jack to the A.G.C. buss of the test receiver video I.F. stages. Set the R.F. Attenuator of the Analyst to number 10, maximum R.F. output. Since the bias supply is very low impedance it will take over control from the high impedance A.G.C. system. In other words, the A.G.C. bias being fed back from the A.G.C. network is completely overcome by the bias voltage we are feeding in from our supply. We can now control the A.G.C. bias and therefore the test receiver gain. Adjusting the bias supply varies the receiver gain. With the bias supply set to —50 volts the receiver will be cut off and no picture will be seen. As the negative bias supply voltage is reduced a picture will become visible. Most receivers will begin to show a picture in the region —6 to —12 volts. As the bias voltage is reduced even further the picture will begin to overload. This will usually show up as snaking in the picture due to sync clipping. If the bias is reduced even further the picture will get blacker and then will reverse phase and then completely disappear at zero bias, indicating complete blocking of the receiver. Disconnect the bias test leads and restore the test receiver to normal operation.
27. Connect the R.F. output of the Analyst to the R.F. antenna terminals of a color TV receiver. Tune the receiver to an unused TV channel tune the Analyst to that same channel as described above. With the black and white test pattern showing, on the Color TV screen, turn the Color Switch to "On". This will switch on the 3.58 mc color rainbow generator signal. This signal will produce a color spectrum. The color sequence of the spectrum is as follows: Reddish Orange at the extreme left side of the tube, followed by a gradual transition to Red, Magenta, Blue, Cyan and Green at the right side of the tube. This color rainbow signal can be used to isolate defective stages in the color section of the color TV receiver. This chroma signal can also be fed into the I.F. section. By taking the color signal from the 3.5 mc color jack it can be fed directly into the video and chroma sections.

TROUBLE SHOOTING WITH THE TELEVISION ANALYST

The Television Analyst provides the service technician with a powerful tool to quickly and accurately trouble shoot television receivers. Outputs are provided, to enable the service technician to inject signals into any section of a TV receiver to isolate trouble to (1), a section of a receiver, and (2), to the specific stage. In many cases it is also possible to locate the exact defective component. This method of trouble shooting is called signal injection. The Television Analyst provides output signals which can be injected into any of the stages shown in Fig 4. The indication as to whether or not that portion of the receiver is capable of processing the television signal properly is seen directly on the screen of the television receiver being serviced. Signal injection is best accomplished by starting at that portion of the receiver that is farthest from the antenna.

For example:—a defective receiver is to be serviced where the complaint is "no video". Refer to Fig 4. The farthest point from the antenna in this case would be point J, the grid of the picture tube. The high level signal from the Sync output jack would be injected at this point. If the picture tube is capable of showing video, black and white blanking bars running out of sync will be seen. If the Phase of the sync signal is reversed with the Sync Amplitude control the phase of the Black and White bars will be reversed. The signal must of necessity be out of sync since the sync take off point in most receivers occurs in the video amplifier section of the receiver.

Since the picture tube circuits checked out we must now inject a video signal at point H, the grid of the 2nd video amplifier. This video signal is obtained at the Video Output jack on the Television Analyst. If the 2nd video amplifier is working properly the test pattern will be displayed on the picture tube. The signal should also be in sync since the sync take off point occurs in the second video amplifier. The proper phase of video must be selected by means of the Video Polarity switch located directly above the Video output jack. We now move our video test signal to point F, the grid of the first video amplifier, as shown in Fig. 4. Remember to reverse the phase of the video signal to account for the 180 degree phase reversal that occurs in the first video amplifier. If the test pattern failed to appear on the picture tube with the signal injected at point F we would know that our trouble must lie between point H and point F. Obviously the first video amplifier is defective. A few voltage and resistance readings will quickly locate the defective component.

If however, with the test signal injected at point F we saw a test pattern on the picture tube of the receiver, we would then have to inject a signal at points E, D and C (the grids of the I.F. amplifiers) at the I.F. frequency of the receiver. This is done by setting the R.F.-I.F. Selector switch to the I.F. position and setting the I.F. tuning to the correct frequency. Using the shielded cable provided and connected to the R.F.-I.F. output jack, inject signals to the grids of the third, second and first I.F. amplifier stages. If the test pattern signal should fail to appear on the screen of the picture tube at any of these points then the defective stage has been located. This same technique can be applied to the Tuner, the Sound system, the Sync circuits and the Deflection circuits.

As long as the signal injection point is somewhere along the series path that the signal must travel from the antenna terminals all the way through to the picture tube or loud speaker, this complete signal path can be analyzed in minutes. Included in this series path are all of the series components which are directly involved in passing the signal; for example, inter-stage I.F. transformers, video peaking coils, coupling condensers, etc.

The Television Analyst can also be used to trouble shoot intermittents. The following portions of this manual cover the methods used to trouble shoot other parts of a TV receiver, giving step by step procedures.

HOW TO USE THE TELEVISION ANALYST FOR TROUBLE SHOOTING INTERMITTENTS

TV receivers which come into the shop for intermittent troubles can be extremely time consuming and cause a great deal of irritation to the service man. This is especially true when the technician cannot even isolate the section of the receiver where the source of the trouble is located.

As a typical example, let us assume a TV set has a video coupling condensor (C4) which is opening up at random intervals for just a few seconds at a time.

The block diagram Figure 4 shows all the sections of the receiver. By using the Television Analyst we can inject signals at various points in the receiver and by observing the results isolate the difficulty down to a section or single stage. Once the stage has been isolated it is just a matter of checking the individual components in that stage to determine the actual culprit.

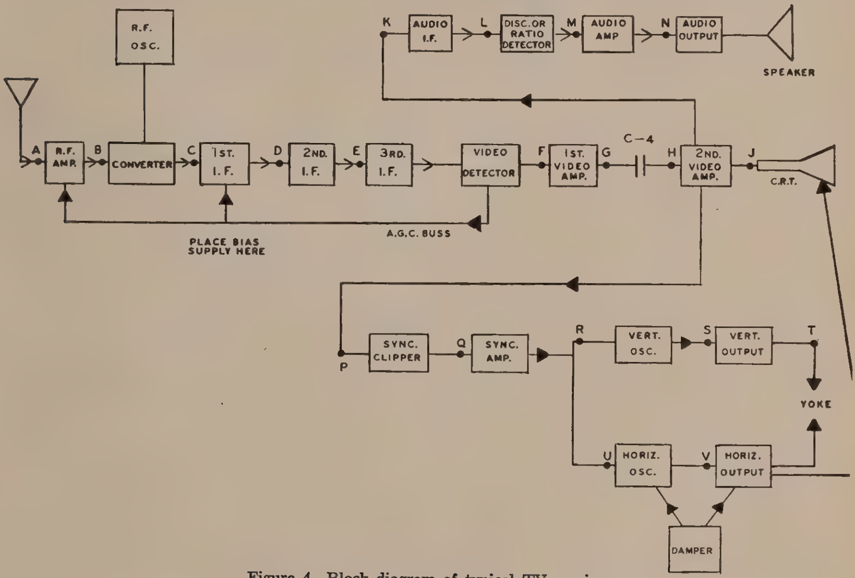


Figure 4—Block diagram of typical TV receiver

Many service men after narrowing an intermittent trouble down to one stage find it economically sound to replace the suspected components one by one until the guilty one is found. When you consider the cost of your time, it is often wise to "waste" a few 20c capacitors to save ½ hour of your time.

In the typical example:—The customer complained that the picture and sound went off for a few seconds every ten minutes. The service man in the field ascertained that when this occurred the raster was still there, eliminating the possibility of A.C. power failure, or D.C. power supply trouble. In order to get a raster, the low voltage supply must be working as well as the complete horizontal and vertical sweep and high voltage circuits.

By looking at the block diagram it can be seen that the video and audio signals are together in all the R.F., I.F. and Video stages. It is after the last video amplifier that the video and audio separate. Since both video and audio are lost when the intermittent trouble appears, it is obvious that the trouble must be in the R.F. tuner, I.F. amplifier, Video detector, Video amplifier or A.G.C. circuits.

The Television Analyst will now be used to locate the source of the trouble. The signals available from the instrument will be injected into the receiver at various points, so that by the process of elimination the trouble can be analyzed down to one stage.

First it is necessary to disable the A.G.C. circuits by connecting a bias supply to the A.G.C. buss which feeds A.G.C. voltage to the tuner and I.F. amplifier stages. (Incidentally, if the trouble were in the A.G.C. circuit, using this external bias supply would probably eliminate any symptoms of trouble. This would indicate that the source of trouble was in the A.G.C. Circuits).

Now by feeding R.F. signal into the antenna terminals of the set (A) the test pattern and sound will intermittently disappear, just as it did on the local TV stations.

By moving our signal injection point stage by stage from the antenna terminals to the picture tube, we can localize the trouble. Still using R.F. ouput, inject the signal on the grid of the R.F. converter tube (B). If the intermittent still appears, it means that the trouble is NOT in the R.F. amplifier stage, or the R.F. oscillator.

Now we switch the instrument output to the I.F. signal, and inject this signal at the same point at the grid of the converter (B). (Note:—If the intermittent appeared when R.F. signal was fed to the grid of the converter, and it did *not* appear when I.F. signal was fed into the grid of the converter, then the trouble would have been pin-pointed directly to the R.F. oscillator).

With I.F. signal fed into the converter grid (B) we find that the intermittent still appears. That means the R.F. oscillator is not causing the trouble.

Now we move our signal cable to the grid of the first I.F. amplifier (C). Finding the trouble still intermittently appearing, we move our signal to the second (D) and the third (E) I.F. stage. (Obviously, if the trouble appeared when injecting on the grid of the second I.F. stage (D), but no longer showed up when injecting signal to the third I.F. stage (E), the trouble would have been pin-pointed to the second I.F. stage).

Since the intermittent still appeared, the Television Analyst signal output is now switched to Video and the signal is injected into the video detector load. (See Figure 5). This is usually around a 4,000 ohm resistor and can easily be located because it will have a video peaking coil associated with it. (Note:—For video signal make sure you are using the correct output cable as it is *not* taken from the same output jack as the R.F.-I.F. signals. Also, if the picture appears negative, reverse the polarity of the video signal with the Video Polarity (+ or —) Switch).

Since the intermittent trouble still appears, the video detector has been eliminated from suspicion and the video signal is injected on the grid of the first video amplifier (F). The intermittent trouble still shows up at this point.

The video signal is now injected into the grid of the second video amplifier tube (H) after reversing the polarity with Video Polarity (+ or —) Switch to compensate for the 180° phase reversal in the first amplifier tube. Now, for the first time, the intermittent disappearance of sound and video is no longer evident. The trouble has been isolated to an area between the grid of the first video amplifier (F) and the grid of the second video amplifier (H).

Now to use the Television Analyst once more to check the coupling capacitor (C-4) from the plate of the first video amplifier to the grid of the second video amplifier. Inject the video signal on the plate side (G) of the coupling capacitor (See Figure 5). The intermittent condition again appears, placing the blame for intermittent loss of signal to the coupling capacitor C-4 which is opening up intermittently.

(If it were the first video amplifier tube itself, screen bypass capacitor C-1, plate load resistor R-2, peaking coil L-4, or any other component in the first video amplifier circuit, the trouble would not have appeared with the signal injected at point (H) in the circuit. However, if the signal was injected at point (K) on the plate of the first video amplifier and the same intermittent indication appeared, then both the peaking coil L-3 and the coupling capacitor C-4 would be suspected).

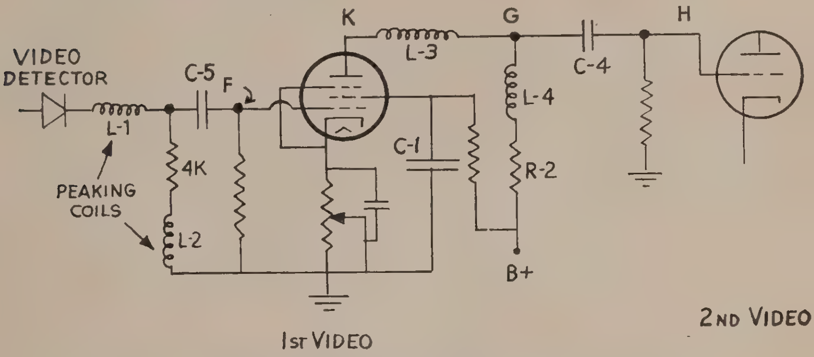


Figure 5—Video section of typical TV receiver

It should be clear at this point that the signal injection procedure can actually begin at either end of the circuit. That is, we could have started at video and worked toward the R.F. Tuner, or start at the Tuner and work toward the Video. Each individual technician will develop his own technique for use of the instrument. Where the trouble is an intermittent one, then it is sometimes preferable to start at the tuner because we are looking for a "drop out or loss" of signal for short intervals.

Where the trouble is in the circuit constantly, it may be preferable to start at the video end and work toward the R.F. tuner. Also it is evident that as the technician becomes more familiar with the instrument he will skip stages for quick analysis and take complete sections at one time (I.F., R.F., Video). After determining which section is at fault, he could then signal inject to find the one stage or component which was at fault.

Let us take another example of a receiver which comes into the shop having intermittent sync. The sync circuit of this receiver is shown in Fig. 6. Let us trouble shoot by signal injection from the rear of the signal path. We inject sync signal from our Television Analyst to the plate of the 6BF6 sync amplifier. We would now observe the raster of the television set and would see that it was in sync.

If the picture now remains in sync, this would tell us that from the plate of the sync amplifier tube into the oscillators there was no trouble. We would now shift our point of sync injection to the grid of the 6BF6 sync amplifier. At this point we would have to reverse the phase of the sync signal to allow for the phase inversion of the sync amplifier tube and also reduce the level of the sync signal to take into account the gain of this stage. Again we would observe the picture on the face of the tube and watch for the intermittent trouble to occur. If it did not occur, we would know that there was no difficulty from the grid of this amplifier tube all the way through to the oscillators.

We will now shift our sync signal to the plate of the 6AU6 sync separator and again observe the picture on the face of the CRT. We now find that the intermittent sync condition occurs. This tells us that the trouble lies between the plate circuit of the 6AU6 sync separator and the grid circuit of the 6BF6 sync amplifier. A few voltage and resistance measurements would now certainly point out the trouble. It might even be worth while to replace all of the components that lie between plate of the 6AU6 and the grid of the 6BF6, since this would save a great deal of time and would eliminate the necessity of determining which component is intermittent.

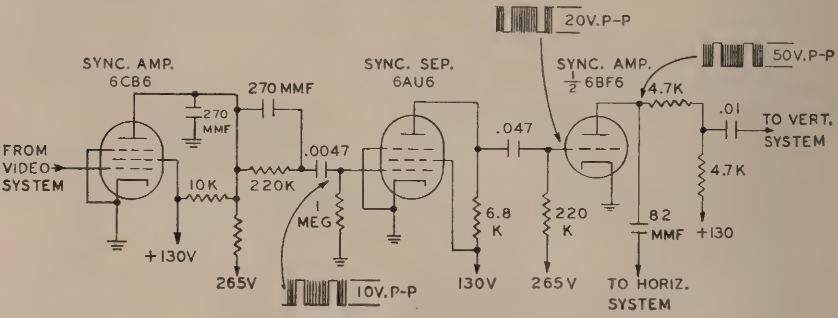


Figure 6—A sync separator system

As you can see, this sync injection method for locating intermittents will in every case isolate the trouble to a particular stage. From that point on the repair is very simple.

HOW TO USE THE TELEVISION ANALYST FOR TROUBLE SHOOTING LOSS OF AUDIO

This trouble shooting procedure for Audio I.F. Stages applies to intercarrier type of sets.

Let us assume there is no audio in a TV receiver. Within a couple of minutes we will find the defective stage by using the Television Analyst. Refer to Fig. 7. Assume a shorted screen bypass capacitor (5000 mmf) on the 4.5 mc Audio I.F. amplifier.

To check the speaker and audio output stage, inject the 400 cycle audio tone on the grid of the audio output tube (point A). A good tone will be heard. Then move the signal injection point to the grid of the audio amplifier (point B). Now use the 4.5 mc audio I.F. output with 400 cycle tone modulation and inject the signal at the plate of the sound I.F. amplifier (point C). You will still hear the tone signal indicating all the stages from this point to the loudspeaker are O.K. Now the 4.5 mc signal is injected on the grid of the 4.5 I.F. amplifier (point D), and the tone signal is no longer heard in the loudspeaker. This immediately tells you that the trouble is in this stage. A simple voltmeter test will discover the bad component, as no B+ or very low B+ will appear on the screen of this tube. It is always a good practice to check the screen dropping resistor under these conditions, to see if the excessive current has caused it to increase in value.

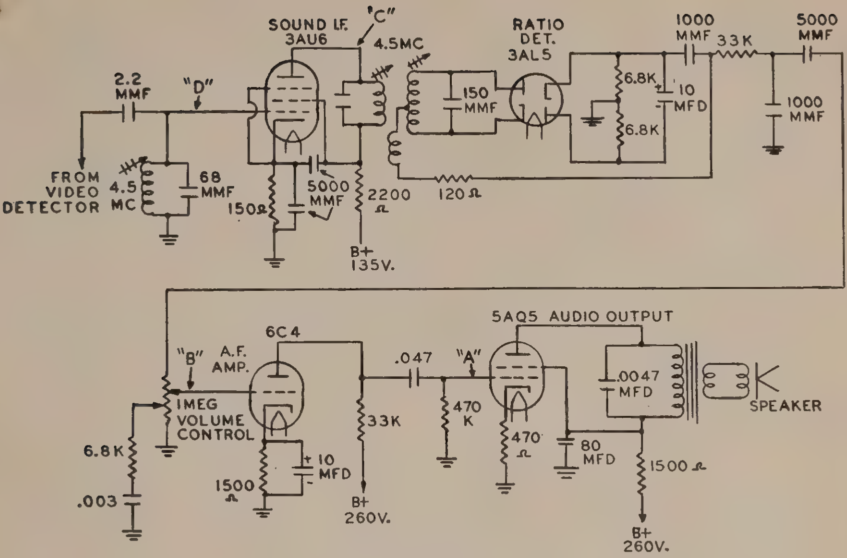


Figure 7—A typical TV audio system

HOW TO TROUBLE SHOOT SYNC AMPLIFIERS AND SYNC SEPARATOR STAGES

With the Television Analyst it is possible to quickly and thoroughly check the sync separator stages of any television receiver. To illustrate the procedure to follow, three representative sync separator sections will be discussed.

A fairly simple sync separator system is shown in Fig 8. This is seen to consist of the two triode sections of a 7AU7. We will assume that the picture is completely out of sync vertically and horizontally and we wish to check out these stages to determine if the trouble lies here.

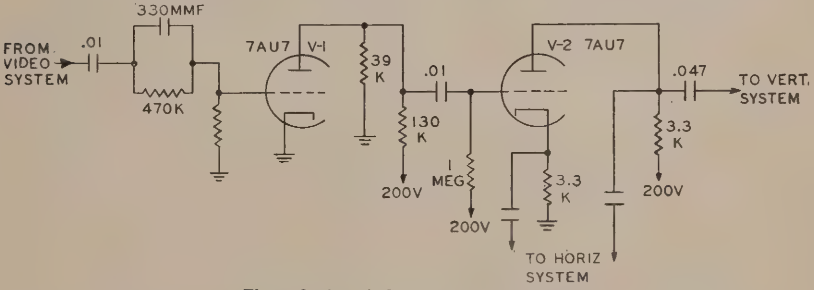


Figure 8—A typical sync separator system

As a first step, connect the Television Analyst to the receiver so that an image appears on the screen. The point of signal injection may be at the antenna terminals. It would be desirable not to inject the test pattern signal into the video amplifier stages because we might do this beyond the point where the sync signal take-off occurs. Rather than spend time looking for this point, inject the signal as indicated above.

The next step is to apply a composite sync signal from the Television Analyst to the grid (and chassis or B—) of V2, Fig. 8. It is important that the proper polarity sync signal be applied and ordinarily the technician would have to figure this out by checking through the schematic. With the Television Analyst such checking is not necessary. Simply apply the sync pulses from the Television Analyst to the control grid of V2. If the image on the screen locks into sync, we know the sync signal is passing through V2 and locking in the vertical and horizontal oscillators, and we have chosen the proper phase of sync signal.

If the picture on the screen remains out of sync then reverse the polarity of the sync signal by turning the Sync Amplitude Control to the other phase. This is the reason we do not have to know the proper sync signal polarity before hand. The Analyst permits us to try both phases by simply rotating the Sync Amplitude control. The picture will lock in now, if both deflection systems are operating normally.

If the picture still remains out of sync, the sync pulses are not reaching the vertical and horizontal sweep oscillators. In that case inject the sync pulses at the plate of V2 and repeat the procedure. The receiver should now sync indicating that the trouble must lie between the grid circuit and the plate circuit of V2.

If application of the test pulses at the grid of V2 does lock the picture in, shift the signal injection lead to the control grid of V1. Inability to sync the picture indicates a defect in V1 or its associated circuit. Voltage and resistance checks should then uncover the faulty component.

The level of the test sync pulses may be set at any point between 0 and 50 volts. In most instances, a mid-setting of the sync level control will serve satisfactorily. However, if you find that the full 50 volts peak-to-peak must be used in order to secure adequate synchronization, chances are there is something defective in the circuit. It may be that the pulses are not being properly amplified or that some component has radically changed its value, reducing the stage gain far below its normal figure. It is also well to keep in mind that the level of the injected sync pulses should be lowered whenever the signal lead is moved from plate to grid of a stage, or in going from the grid of one stage to the grid of a prior stage. In short, whenever you add more stages through which the pulse signal must pass, lower the output of the Sync Amplitude control.

Since the Sync Amplitude control is calibrated in volts, any level of signal required may be injected into a receiver sync system. A schematic may indicate that 35 volts peak-to-peak may be required to drive a particular stage. By setting the sync level control to 35 and injecting sync at this point you may determine if that stage will work properly with this level of signal.

A more elaborate sync separating system is shown in Fig. 9. The method of approach is still the same, however. That is, when a symptom of poor synchronization appears, you inject the composite sync signal from the Television Analyst at the plate and grid of each stage in the sync separation system, working from the stage closest to the deflection systems back to the stage that receives the initial video signal from the video system. The only thing to remember is that sync polarity must be reversed when switching from plate to grid. Failure to observe this precaution may erroneously lead you to believe that a stage is defective.

As a precautionary rule, whenever you reach a point in the sync separator system where the injected pulses do not lock in the picture, try both polarity pulses. If you find that one polarity of sync pulse does lock in the picture, the stage is operating satisfactorily.

Within the past few years pentagrid tubes have been employed for the sync separating function, at the same time also helping to reduce the amplitude of any noise pulses that may be riding along with the signal. A typical circuit of this type is shown in Fig. 10. There is a 6BY6 pentagrid tube followed by a triode sync amplifier. A fairly small video signal with the sync pulses negative is fed to grid No. 1. The sync stabilizer control connected to the grid is adjusted so that tube current just flows with normal input signals.

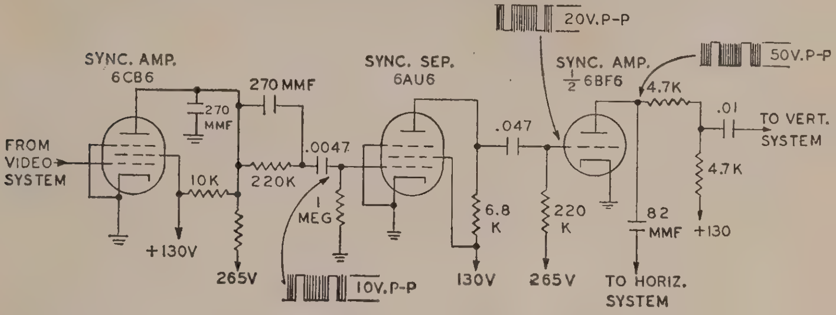


Figure 9—A more elaborate sync separator system

An amplified version of the same video signal, with the sync pulses positive now, is obtained from the plate of the video amplifier and applied to grid No. 3 of the 6BY6. These sync pulses are strong enough to cause grid currents to flow in this circuit, charging capacitor C1 to a value approximately equal to the peak-to-peak amplitude of the applied pulses. In the interval between pulses, the negative voltage on grid No. 3 is high enough to prevent current from flowing through the tube. Thus, when the circuit is operating normally and a video signal is received, current will flow through the 6BY6 only during the sync pulse interval and only sync pulses will appear across the output load resistor.

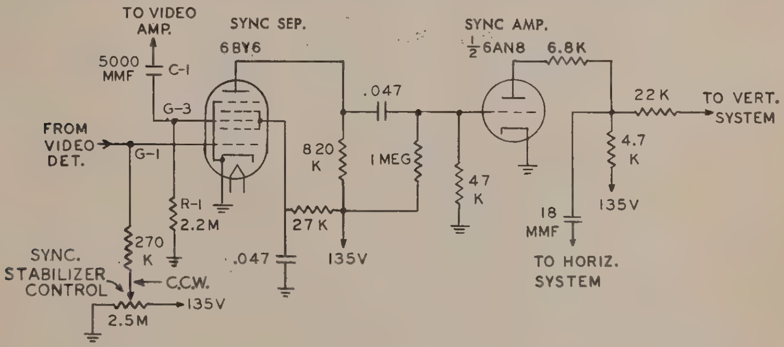


Figure 10
Sync Separator System

Consider now what happens when noise pulses appear at the same time. These noise pulses will be transferred first to grid No. 1 and if they are strong enough, they will cut this grid off. The same noise pulses, reversed 180°, will appear at grid No. 3. However, since grid No. 1 has cut the current off, nothing will appear in the plate circuit. In this way the 6BY6 suppresses any pulses which arrive stronger than the sync pulses. The pulses received from the 6BY6 by the following triode (½-6AN8) are then amplified and forwarded to the vertical and horizontal deflection systems.

To check out such a system when non-synchronization occurs, we would proceed as follows. With the set in operation, apply a composite sync pulse from the Analyst to the plate of the 6AN8 triode. If the picture locks in, reverse the polarity of the sync pulses and apply them to the grid of the same tube. If the circuit is functioning normally, the picture will again become synchronized. Now reverse the polarity of the applied sync pulses again and then touch the probe to grid No. 3 of the 6BY6. If the picture synchronizes, the sync separator system is functioning normally. If the circuit does not permit sync pulses to pass through, trouble in the 6BY6 stage is indicated. While the pulses are being applied to grid No. 3 of the 6BY6, rotate the sync stabilizer control in the receiver completely counter-clockwise. This places 0 volts on grid No. 1 and permits plate current to flow through the tube.

If injected test pulses at grid No. 3 synchronize the image but the receiver, without the injected sync pulses, still displays the same lack of synchronization, then the path between the 6BY6 and the preceding video system should be checked. Move your probe back component by component, until you reach the video system. An open capacitor, an open resistor or a shorted shunt capacitor will be readily uncovered by this point-to-point tracing method.

The sync pulses delivered by the Analyst are powerful enough to be applied directly to the integrator network leading into the vertical oscillator or to the capacitor leading into the horizontal phase detector. Thus you can trace the signal path from these two deflection systems all the way back to the video amplifier system of the receiver.

HOW TO TROUBLE SHOOT A.G.C. SYSTEMS

Locating defects in the A.G.C. (Automatic Gain Control) system in a television receiver represents one of the more difficult troubles that the technician is called upon to service. The first step that must be performed is the positive proof that the trouble lies in the A.G.C. system. Once this has been established the location of the defect will be relatively simple.

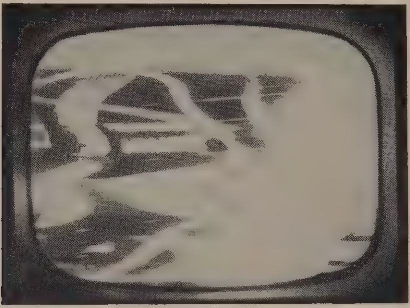


Figure 11—The appearance of an image produced when one of the video I.F. stages has been overloaded

Let us take as an example the case of a television receiver where the customer complains of a picture that seems to be negative and out of sync. The Television Analyst is connected to the antenna terminals of the receiver and the test pattern signal tuned in. The displayed picture appears in Fig. 11. We must now take the video output signal from the Analyst and inject this signal to the grid of the 1st video amplifier. The result is viewed on the television receiver's picture tube. We observe that the displayed picture is satisfactory and we see the normal test pattern signal appears properly in sync. We must therefore conclude that the trouble does not lie in the video portion of the receiver. We now select an I.F. signal from the Television Analyst of the proper frequency and inject this signal to the grid of the 1st Video I.F. amplifier. This is point A in Fig. 12. Examination of the picture displayed on the receiver picture tube shows a negative picture that is out of sync. This is the same result that we saw in Fig. 11. Therefore, the trouble apparently lies in the I.F. portion of the receiver. We will now try to isolate the trouble to a specific stage.

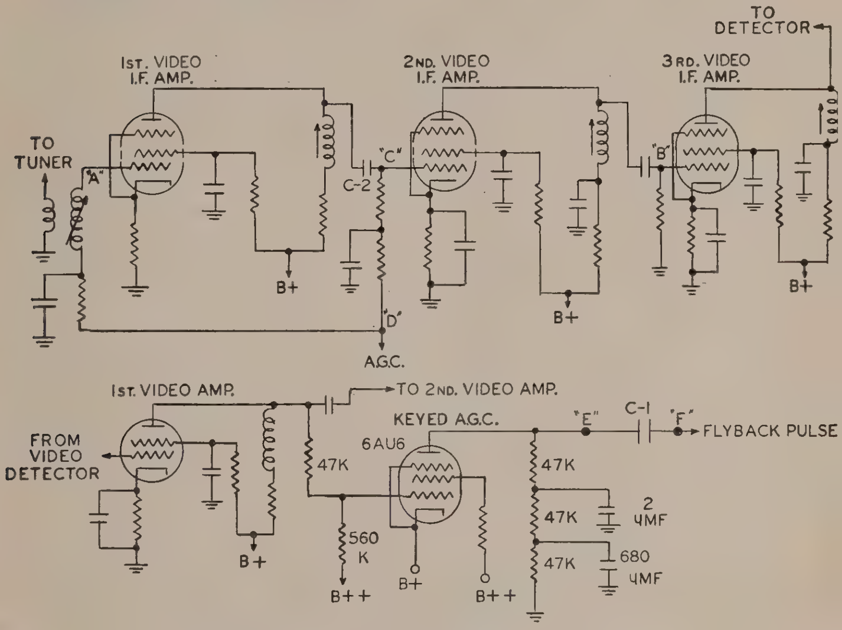


Figure 12—Video I.F. system and Keyed A.G.C. circuit

Since the trouble has been isolated to the video I.F. stages we will now examine each stage in turn to locate the difficulty.

Inject I.F. signal at point B which is the grid of the third video I.F. amplifier. We now observe on the screen that the picture appears to be normal. That is it is of the proper phase and is in sync. Notice that this stage is not controlled by A.G.C. The signal might be a little weak since very little gain is obtained using only one stage of video I.F. amplification. We now move our I.F. injection signal to point C, (the grid of the 2nd I.F. Amplifier) and again observe the result on the receiver picture tube. We now see that the receiver display is negative and out of sync. The trouble apparently is in the second video I.F. stage. Examination of the schematic of Fig. 12 will show that both the second I.F. stage and the first I.F. stage are subject to the controlling action of A.G.C. voltage.

Since the picture displayed in Fig. 11 could be caused by overload of the I.F. stage it might be wise at this point to determine the signal handling capabilities of these stages. By reducing the setting of the R.F.-I.F. Attenuator on the Television Analyst we are capable of lowering the level of the I.F. output to very low levels. As the amount of I.F. is reduced we reach a point where the picture on the customer's receiver no longer appears negative and is in sync. The picture will very likely be snowy as the signal is very weak at this point. We have now proved that the receiver is capable of handling a very weak signal but is certainly not able to handle a strong signal. This definitely points to an A.G.C. defect. The next step is to see if the I.F. strip will accommodate a strong signal if an external bias voltage is used to control the gain. With the I.F. signal injected at point C we connect a test lead from the bias supply of the Television Analyst to point D which is the A.G.C. feed point. A ground lead from the Television Analyst must also be connected. With the Negative Bias control set to —50 we see that the picture has completely disappeared. This is due to the fact that with this large bias we have cut-off the I.F. amplifier. As the bias voltage is reduced we will observe that a picture will begin to appear at around 6 to 12 volts. At about 3 or 4 volts we observe a normal picture and as the bias is reduced even further the sync begins to get unstable and then finally turns negative. These tests conclusively prove that this I.F. stage in the receiver is capable of handling without overload a wide range of signals running from the very weak to the very strong only if external bias control is exerted on the I.F. stage. This proves conclusively the trouble must be related to the A.G.C. circuits. Remove the negative bias lead.

The receiver under test employs a keyed A.G.C. system, which depends for its operation on a high level pulse which is derived from the horizontal deflection system. The absence of this pulse will render the A.G.C. inoperative, and cause the receiver to overload. We now disconnect capacitor C-1 at point E. Connect a test lead from the A.G.C. Keying Pulse jack on the Television Analyst and insert this high level pulse at the plate of the A.G.C. tube (E). We now see that the picture on the receiver screen has been restored to normal operation when I.F. signal is injected at point C, the grid of the 2nd I.F. amplifier tube. The trouble could be a defective C-1 or an open winding on the coil supplying the A.G.C. pulse. Reconnect C-1 and try inserting the A.G.C. pulse at point F. If proper operation results then C-1 is O.K. A resistance reading in this case will immediately show that the pulse coil is the defective component.

Another example of an A.G.C. trouble is as follows. A receiver having the same symptoms as the previous example is to be repaired. Signal injection has isolated the trouble to the 2nd video I.F. stage. We find that by reducing the I.F. Attenuator control until the signal is at a very low level that a normal picture results. We now connect the negative bias supply to point D in Fig. 12 which is the A.G.C. bias buss. We find that adjustment of the Bias Control will not result in a normal picture at any setting of the control, with signal injection at point C at the I.F. frequency. These two tests indicate that the I.F. strip will amplify, as indicated by its ability to show a picture when the signal is very weak. However when the signal is very strong, a control voltage placed upon the A.G.C. buss has no effect on the stage as indicated by the use of the negative bias supply. This would indicate that if the A.G.C. system were operating normally it would have no effect on the stage gain and therefore the trouble must be peculiar to the 2nd video I.F. amplifier and must not relate to the control voltage that the A.G.C. system exercises. This points to the Grid circuit. A few voltage and resistance checks indicate a slight positive voltage on the grid of the 2nd I.F. amplifier. A positive voltage was found on the grid of the stage and a resistance check showed a leaky C-2.

In summary the receiver I.F. system must pass two tests to establish that the trouble is specifically in the A.G.C. First it must be capable of amplifying a very weak signal without distortion. Secondly, with a strong signal input and an external bias supply, control can be maintained. If both of the conditions are met then the trouble is definitely A.G.C. If only one test is passed then the trouble must be peculiar to the I.F. stage under test.

TROUBLE SHOOTING VERTICAL SWEEP CIRCUITS

The following steps should be taken when checking the vertical deflection systems. We will assume that the indications on the television receiver screen to be tested reveal that there is no vertical driving voltage being delivered to the vertical winding of the deflection yoke resulting in a horizontal line on the picture tube.

In order to isolate the defects in a receiver between the vertical oscillator stage and the vertical output stage, proceed as follows:

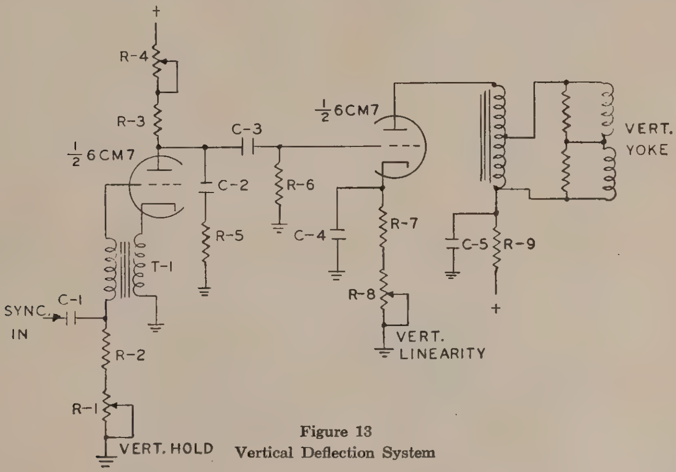


Figure 13
Vertical Deflection System

1. Using the Vertical Grid Drive pulse available on the front of the Television Analyst, apply this signal to the vertical output stage grid (see Fig. 13). If, when this signal is applied, the image develops vertical deflection, then we know that the proper driving signal is not being supplied to the output stage by the vertical oscillator. The defect is either in the oscillator itself or in the capacitor (C-3) coupling the oscillator to the output stage. However, if vertical deflection of the image does not occur when the signal is injected at the grid of the output stage, the defect is located somewhere between this grid and the deflection yoke.

   The grid driving pulse signal may not necessarily result in linear deflection on the screen of the television receiver. However, we are primarily interested in the presence or lack of deflection. A closer approach to good linearity can be obtained by adjusting the linearity control in the receiver (R-8) in Fig. 13 and by adjusting the Vertical Drive Amplitude control located on the front of the Television Analyst. In all cases this control should be at maximum when first starting to troubleshoot vertical deflection systems.

2. Assuming that no vertical deflection results when the signal is injected at the grid of the output stage, inject the Vertical Plate Drive pulse from the Television Analyst at the plate of the vertical output

tube. The vertical output tube itself is removed from the set. In sets where the heaters are series-wired, the filament terminals on the socket can be shorted out, so that all the other tubes in the series string will continue to operate.

We are now driving the output transformer from the vertical output stage contained within the TV Analyst. However, the B+ applied to this remote output stage in the instrument is derived from the receiver circuit itself. If vertical deflection is restored with this plate signal, the defect is in the vertical output stage, generally in the cathode circuit, assuming the tube to be good. If the vertical deflection is still missing then it indicates that either the vertical output transformer or the vertical windings of the deflection yoke are at fault.

We are assuming, in the preceding paragraph, that B+ is reaching the plate of the vertical output tube. This B+ is required by the TV Analyst to power its output tube. If no B+ should be present, no signal will be obtained from the PLATE DRIVE terminal. Hence, if application of the test lead from the instrument at the plate of the output stage does not produce vertical deflection, it would be desirable to check the voltage in this circuit to make certain it is present. Absence of the necessary voltage indicates an open circuit in the vertical output transformer winding, or an open resistor or shorted capacitor in the B+ network bringing this voltage to the vertical system.

To check the vertical windings of the deflection yoke, disconnect its wires from the circuit and connect them to the two test leads from the Vertical Yoke Test Signal jack and GROUND of the TV Analyst. If the yoke is good, vertical deflection of the picture tube image will result. The image will possess poor linearity and overlap or go back itself (Fig. 14) because the driving signal is a sine wave and not a sawtooth. However, we are not concerned here with checking linearity and, therefore, any indication of deflection would reveal the yoke to be good. The trouble now is definitely indicated to be in the vertical output transformer.

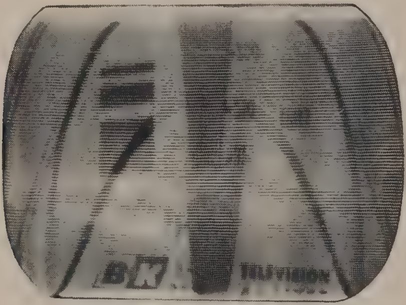


Figure 14—Sweep developed using vertical yoke test signal

TROUBLE SHOOTING HORIZONTAL DEFLECTION CIRCUITS

We come now to the horizontal circuit of a television receiver and it is here that the instrument offers the service technician several quick test features that will greatly simplify the task of servicing this section of the set.

One such outstanding feature is the ability to check the output circuit completely, both from the grid of the horizontal output tube and from the plate of this stage. In essence, then, we can completely bypass the horizontal output tube. A second innovation is two indicator lights which further serve to pin-point troubles in the output transformer, or the high voltage network. The lights operate on a "go - no-go" basis, clearly revealing to the serviceman the presence or absence of certain hard-to-find troubles.

And last, but not least, sensitive leakage and shorted-turns tests can be made quickly and conclusively on yokes and horizontal output transformers, again providing the user with positive information.

Let us assume the receiver under test has no picture or raster and there is an absence of high voltage.

1. In order to determine whether the defeat lies in the horizontal oscillator stage or the horizontal output amplifier and the stages following it, proceed as follows:

   Using the Horizontal Grid Drive pulse available from the front panel of the TV Analyst apply this signal to the grid of the horizontal output tube. Connect the high voltage indicator lamp to the insulated wire going to the plate cap of the high voltage rectifier tube and remove the plate cap from this tube. See Fig. 15. Apply power to the receiver under test and observe the high voltage indicator lamp.

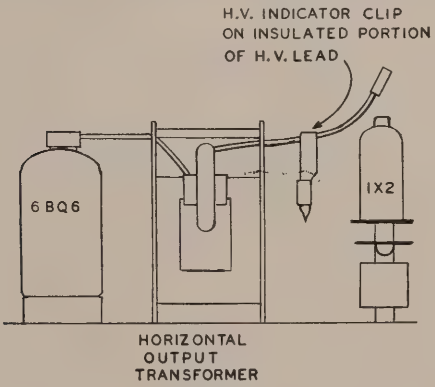


Figure 15—Connecting High Voltage Indicator

If the lamp glows this indicates the presence of high level R.F. pulses on this lead. Turn off the power and reconnect the high voltage plate lead to the rectifier tube and again apply power. If the high voltage rectifier circuit is O.K., the lamp should still remain lit and hi voltage should be present and deflection will be observed on the face of the CRT. Since the application of a driving pulse to the grid of the horizontal output resulted in restoring operation to the receiver the trouble definitely lies in the horizontal oscillator circuit. A few voltage and resistance checks will certainly bring the trouble to light.

Let us take another case where no hi voltage is again the trouble. Application of grid driving pulses do not restore hi voltage or deflection. This indicates that the trouble is not in the horizontal oscillator but that the difficulty lies in the output circuit of the receiver. Turn the Plate Drive Selector switch of the Television Analyst to the Horizontal position. Connect the ground lead of the instrument to chassis ground or B— and connect a test lead from the Plate

Drive jack to the plate lead connection on the horizontal output transformer. Be sure the hi voltage indicator lamp is connected to the plate cap lead going to the hi voltage rectifier and that this lead is removed from the plate cap of the tube. Apply power to the receiver and observe the B+ boost indicator lamp on the front of the TV Analyst and the hi voltage indicator.

If both the B+ boost indicator and the hi voltage indicator lamps come on, they indicate the presence of boost voltage in the flyback system and hi level R.F. pulses in the hi voltage lead. Both of these indications tell us that the flyback system is now operating properly. The trouble must be in either the high voltage rectifier circuit or the output tube circuit. To eliminate the hi voltage circuit, reconnect the plate cap of the hi voltage rectifier tube, apply power to the receiver, and again observe the boost indicator and the hi voltage indicator. If both are lit this indicates that the high voltage rectifier circuit is O.K. We must still check whether the high voltage dropping resistor R-4 is open, preventing the high voltage from getting to the picture tube. If R-4 is O.K., then this proves conclusively that the trouble must be in the horizontal output tube circuit. It could be the screen resistor R-1, or by pass condenser C-1, or the cathode bias resistor R-3. (See Fig. 16)

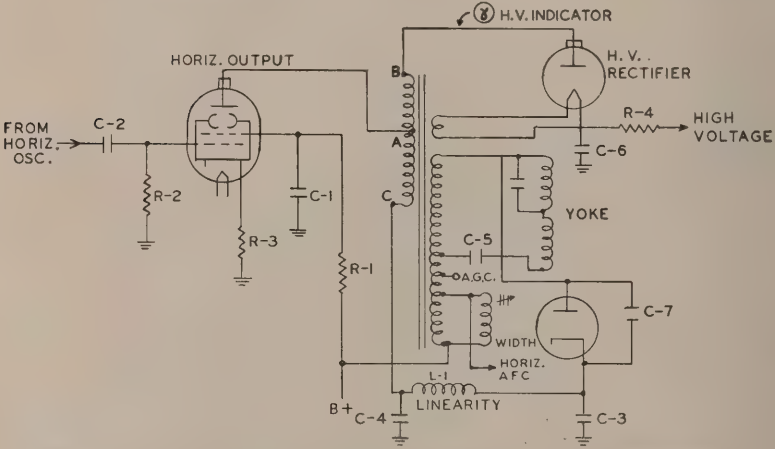


Figure 16—A horizontal output section using an isolation type of output transformer

Screen voltage is applied to the horizontal output tube through the screen dropping resistor R-1. There is also a bypass capacitor C-1 between the screen grid and ground. If resistor R-1 increases in value, the screen voltage will decrease, there will be less drive to the horizontal output transformer, and the picture width will decrease. If R-1 opens up, there will be no drive and no high voltage. Generally, if R-1 is open it will be found that capacitor C-1 has shorted and the excessive current drain has caused R-1 to burn out. In this case, both C-1 and R-1 should be replaced. As a matter of prudence, whenever R-1 has been found to increase in value substantially, it is good practice to change capacitor C-1 because it frequently is the cause of such resistance change.

In the grid circuit of the horizontal output stage, grid leak resistor R-2 and coupling capacitor C-2 bring the signal to the horizontal output stage from the horizontal oscillator. This coupling capacitor is frequently the cause of much difficulty in the horizontal output circuit. If C-2 becomes leaky or shorted, a positive voltage will be applied to the control grid of the horizontal output stage from the plate circuit of the oscillator. If the leakage resistance of C-2 is low enough, this could load down the horizontal oscillator circuit sufficiently to prevent any horizontal output or high voltage from being developed.

It is interesting to note, that if C-2 is leaky, with a fairly low resistance, applying the grid driving pulse to the horizontal output stage from the Analyst may not cause the high voltage to reappear since the shorted coupling capacitor may load down the Analyst circuit as well. To see if this is so, uncouple one side of C-2 and reapply the grid drive. If the high voltage now appears, capacitor C-2 should be changed.

2. If you find that injecting the signal from the TV Analyst at the plate of the horizontal output tube *does not* restore high voltage, then the trouble lies somewhere in the circuit *beyond* the horizontal output stage. NOTE: This is a *conclusive* test and it due *entirely* to the fact that the TV Analyst can take the place of the horizontal output amplifier.

   The procedure to check out the output circuit with the instrument is as follows:

   The cap lead is lifted from the top of the horizontal output tube; also the cap lead connecting to the high voltage rectifier is removed from its tube. As an added precaution, the high voltage rectifier tube is removed from its socket. The TV Analyst is then set to deliver a horizontal plate driving pulse. The lead from the Plate Drive terminal is connected to the cap lead that ordinarily goes to the horizontal output amplifier. Next, the B & K high voltage indicator light is attached directly to the *insulated* wire leading to the cap that connects to the high voltage rectifier. (See Fig. 15). The instrument and the television receiver are both turned on.

   If the boost indicator light on the panel of the TV Analyst lights up, as well as the high voltage indicator, high voltage is being developed, boost B+ is present, and R.F. is being produced in the circuit. This is the condition that would generally be obtained when the set is working normally. In the present instance, the set is presumed to be defective; therefore, if such an indication is obtained, but there is no high voltage on the picture tube as indicated by lack of raster, it is possible that capacitor C-6 in Fig. 16 may be shorted, or the high voltage cable is not connected to the CRT. (We are assuming that all the tubes in the circuit including the picture tube have previously been checked before any testing with the instrument is begun.)

   Another possible cause of no raster when the hi voltage indicator lights up is an open in the current limiting resistor R-4, preventing any high voltage from appearing on the picture tube. Each of these components can be checked individually to determine which is defective.

   If the boost indicator lights up when the horizontal plate drive is applied to the transformer but the hi voltage indicator *does not* and there is no high voltage, then we have a definite indication that the trouble is in the transformer winding from point A to point B in Fig. 16.

NOTE: For the boost indicator to light up, R.F. pulses must be present on the plate of the horizontal output tube. This, in turn, means that boost B+ must be present, for without this additional voltage, any R.F. pulses produced will be too weak to light up the boost indicator. This makes the boost indicator doubly valuable because it provides a positive indication of whether the circuit is or is not operating.

3. If neither the boost indicator or the high voltage indicator light up, when the horizontal plate driving pulse is applied to the transformer, we proceed in the following manner:

   With a voltmeter, check the DC voltage at the plate of the horizontal output tube. We know that boost B+ is absent and this test is designed to reveal if any B+ is reaching the tube. If zero voltage is measured at this point, then either the voltage is being shorted out by boost filter capacitors C-3 and C-4 or the linearity coil L-1 is open. Short out the linearity coil and test the circuit again. If everything returns to normal, the linearity coil is open. If no change occurs we can presume that the coil is OK.

   Check capacitors C-3 and C-4 for any short or leakages. It should be noted here that a failure of the boost B+ voltage being applied to transformer terminal C will cause very little horizontal output signal because the output tube does not have enough plate voltage. This is because the boost B+ voltage is providing the power for the plate of the horizontal output stage.

   Returning to the damper circuit, if B+ voltage only is measured on the boost B+ line, it indicates that no high pulse voltage is being rectified and added to the B+ to develop a boost B+ voltage. There is another boost circuit defect which can cause this and that occurs when capacitor C-7 (Fig. 16) is shorted. For this condition, the B+ voltage will be applied from the plate of the damper tube to the cathode; there will be no rectification in the damper tube and hence no boost B+ voltage. This possibility can be checked by removing the damper tube from its socket and nothing whether the B+ voltage is still being measured at the cathode terminal of the damper tube socket. If the answer is yes, C-7 is shorted and should be replaced. However, if no voltage is present at the cathode of the damper tube with the tube out of its socket, then C-7 is not shorted and the damper tube can be returned to its socket.

   The role played by the two special indicator lamps provided with the TV Analyst demonstrates how useful they are in assisting the technician isolate a defect in the horizontal output circuit. Once their use becomes understood, they will be found to save many hours of service work.

4. We shall now demonstrate how to locate quickly a defect in the horizontal output system consisting of the transformer itself, the horizontal yoke or any of the associated components attached to these units. To check the horizontal yoke, it is only necessary to disconnect the yoke from the circuit so that any shorting effect a defective yoke might have on the rest of the circuit is removed. If now, with the plate drive signal applied to the horizontal output transformer, the boost indicator lights up as well as the hi voltage indicator showing that high voltage is being produced, then the defect in the set has been isolated to a shorted yoke. As a matter of fact, a vertical white line will appear on the screen of the TV receiver being tested, if the high voltage rectifier has been replaced in its socket. However, if the yoke is not the defective component, there will be no change in indications at this time.

Make careful note where the yoke wires connect in the circuit. Also keep the yoke disconnected while the remaining tests are being made.

Next, the width coil is tested. To do this, it is disconnected completely from the circuit. Note the effect upon the boost indicator and hi voltage lights. If the width coil is defective, its removal from the circuit will bring back the high voltage. Under these conditions, both the B+ boost indicator and hi voltage indicator will light up. If the width coil is in series with the yoke in a particular circuit, remove the width coil at the same time the yoke is being removed. If the high voltage comes back again, one of these components is at fault. Reconnect the yoke first, using a connecting lead in place of the width coil. If the high voltage reappears, the width coil is the defective unit. This conclusion can be checked out by testing the yoke with the Shorted Turns and Leakage Test of the TV Analyst.

It is common practice to tap off pulses from various points on the secondary of the horizontal output transformer for use in the horizontal AFC and in keyed A.G.C. circuits. It may very well be that a defect exists in one of these auxiliary circuits which is having an adverse affect on the horizontal output transformer, loading it down and thereby preventing it from functioning normally. To determine if this is true here, disconnect one tap at a time, each time checking the indicators to see whether high voltage has returned. If the boost and high voltage indicators light up after one of these leads have been disconnected, then we know that the trouble exists in that particular auxiliary circuit. After this, it simply becomes a matter of tracking down the defect in the auxiliary circuit.

It may happen that even after all of the auxiliary components have been removed from the horizontal output transformer neither the boost or hi voltage indicators will light. This certainly points to a defective transformer and the TV Analyst has available the necessary tests to prove that the transformer is defective. At this point it might well be worthwhile to review the nature of defects that can occur in a horizontal output transformer. Some of the more obvious defects that can occur are open windings, shorts from one winding to another, hi resistance leakage from one winding to another or from a winding to the core of the transformer. The instrument provides a test for these conditions. There is another fault that is less obvious. A flyback transformer in operation is subject to both very high voltage pulses and relatively high temperatures. This can cause breakdown between turns in a winding resulting in one or two or more shorted turns within the winding of the transformer. These shorted turns represent a load on the flyback and a serious reduction in the "Q" of the whole system. As little as one shorted turn in a winding can result in an inoperative flyback system. These leakages and shorted turns can also occur in the horizontal windings of the deflection yoke and all of these tests are equally applicable to both. To test these components they must be completely disconnected from the circuit. To test for leakage and continuity the Calibrate control must be turned to the Leakage-Continuity position, which is fully counter clockwise. Connect the test leads to the Leakage Continuity test signal jacks and check continuity of the various windings. Presence of continuity is shown by a glow of the test indicator bulb. When measuring leakage between windings and from winding to core a glow of the test indicator shows that leakage is present. The leakage test will indicate leakage resistance from 0 to 10 megohms. Remove the leads from the Leakage-Continuity test jacks.

To test a transformer for shorted turns connect the shielded cable to the Flyback-Yoke test signal jack. Adjust the Calibrate control until the test indicator lamp just goes out. Connect the flyback transformer to this cable. The connection is made from horizontal output plate cap connector to hi voltage rectifier plate cap connector. If the test indicator glows this indicates that the transformer has shorted turns. This test will respond to as little as one shorted turn. If the component to be tested is the horizontal winding of the deflection yoke, connection is made across the deflection yoke winding. It is also important to test the yoke for leakage between the vertical and horizontal winding and from the horizontal winding to the metal frame of the yoke.

Another very common arrangement is the autotransformer shown in Fig. 17. Here there is one winding to which all taps are made. The horizontal output tube is connected at point A and the stepped-up voltage for the high voltage rectifier tube is obtained from point B. Horizontal deflection yoke coils are connected across points C, D and E. All of the testing methods just outlined for the isolation horizontal output transformer are applicable here, too. The boost indicator and hi voltage still function as before, for the same conditions, and both are connected as before. The ability of the instrument to check for continuity can be put to good use here because continuity should exist between all points on the transformer. If continuity is not obtained, the transformer is open.

In Fig. 17 L-1 serves primarily as a filter coil. If this component should open, no B+ would be available to the horizontal output tube, and if L-1 was shorted, the circuit would still operate normally; it is quite possible that considerable RF interference would appear in the picture. If no interference did appear, there would be no visual indication of a short in L-1. If C-1 should short, the damping tube would be effectively cut out of the circuit and no boost B+ would be developed. B+ voltages, however, would appear on the B+ boost line and at the plate of the horizontal output tube. If C-1 should open, it would have very little effect on overall operation, although here, again, RF interference might appear in the image.

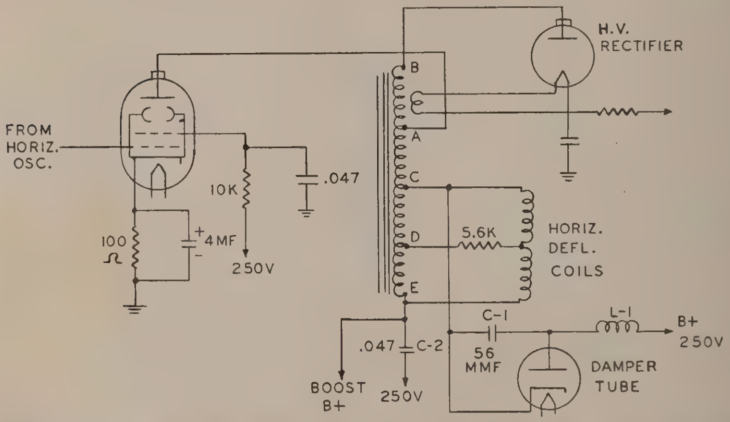


Figure 17—A Horizontal Output Section using an Auto Transformer type of output transformer

Capacitor C-2 is the component receiving the additional voltage which the damper tube develops. If C-2 should short, no boost B+

could be developed by the circuit and it would prevent the development of the normal amount of high voltage or the normal amount of horizontal drive for the yoke. If C-2 should open, the circuit would again be disrupted by the lack of boost B+ voltage. B+ voltage, however, would still appear because the damper tube and L-1 would still be intact.

The foregoing examples indicate the complete flexibility of this instrument. With continuous use the technician will certainly develop his own procedure which will completely remove all of the complexities of Sweep Circuit Analyzing.

TROUBLE SHOOTING CHROMA CIRCUITS

Loss of color, weak color or distorted color can occur in the R.F. or I.F. sections of a receiver as well as in the Chroma Circuits. The Analyst is particularly useful in trouble shooting this type of complaint as either the R.F. or I.F. signal may be modulated with the Rainbow Color signal and this signal injected, into the R.F. or I.F. stage by stage to localize the defective stage.

The Chroma signal is also available at the output jack labeled Color and may be injected directly into the Video Detector, Video Amplifier, Band pass Amplifier or to the grid of low level demodulators.

These tests quickly pin down complaints of no color, weak color, and distorted color. They also localize phase errors by showing the wrong sequence of colors.

Phase errors arise in the Chroma section, or in the I.F. section. It is possible for the R.F. section or Video section to cause phase errors, but these are less common trouble points. If you inject the Chroma signal into the Band pass Amplifier and get a normal color pattern the next step is to inject an I.F. signal modulated with chroma information at the input of the I.F. Amplifier.

When a phase error is found in the latter test, it is indicated that the I.F. Amplifier is in need of proper alignment. On the other hand, a phase error in the former test indicates the need of Chroma circuit alignment.

A color bar pattern slide is enclosed in the accessory package of your Television Analyst to enable you to convert the rainbow pattern which it produces into a color bar pattern of known colors. Too high a setting of the Receiver Chroma Control will result in having only the three primary colors displayed. At this point it might be well to review the principle of operation of a rainbow pattern and then relate it to a color bar pattern.

The different hues that can be produced in a color TV receiver are obtained by shifting the phase of the color sub-carrier of the transmitted signal with respect to the reference burst which occurs during the horizontal blanking interval. For example, if the phase of the sub-carrier is shifted slowly through a complete 360° with reference to the burst signal, the hue will change from yellow to orange, to red then magenta, blue cyan and green, and all of the intermediate hues between those colors. If the phase of the sub-carrier signal is continuously changed thru a full 360° during the interval of one horizontal line and repeats itself for each following horizontal line, a continuous rainbow of colors will be produced. Instead of shifting the phase of the sub-carrier in the TV Analyst, we will make the frequency of the sub-carrier lower than the color oscillator in the TV receiver by 15,750 cycles. There will then be a one cycle per line difference between the sub-carrier and the oscillator in the receiver. Since over a period of one horizontal line there is one cycle difference between the two signals, we have effectively created a 360° phase shift per horizontal line which will repeat itself each horizontal line. This will result in a rainbow display showing each of the colors in the color spectrum from yellow to orange, red, blue and ending in green. This method of producing the color signals is called off-set sub-carrier operation.

By referring to Fig. 18 you will see the vector display of the color information that can be obtained for a phase shift of any given number of degrees. For example, 60° represents a +(I) signal. A 90° phase shift represents + (R-Y). 180° represents + (B-Y) and a +300° represents (G-Y). In order to change a color rainbow signal to a color bar signal, we merely have to blank out those portions of the rainbow display that we do not want and allow the portion of the rainbow that we do want to come through. This we accomplish with the color bar slide enclosed in your accessory package. You will note that there are ten light intervals and nine dark intervals equally spaced on the slide. Each bright interval, or bar, represents a color phase shift of 30° and is so placed on the slide as to give the colors as indicated in Fig. 19. You will note for example in Fig. 19 that the second bar is indicated as orange and its color corresponds to +(I) since it is 60° from the reference signal. The sixth bar for example, is a blue color and corresponds to +(B-Y)

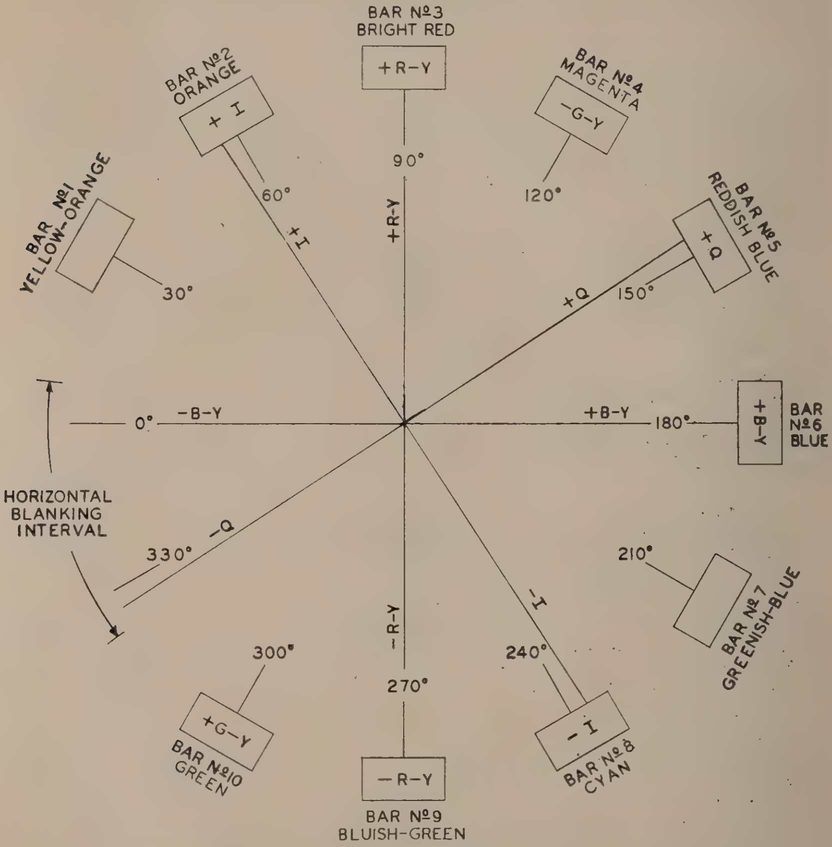


Figure 18—Vector display showing color bars and angular displacement for each bar

since it is 180° from reference signal. Fig. 19 will be extremely useful in servicing color TV receivers since it will enable you to evaluate performance of the receiver. It will also enable you to check the range of the hue control and will provide a simple method of color demodulator alignment.

Since most of the color TV receivers in use today demodulate an +(R-Y) and a +(B-Y) signal, our discussion of demodulator alignment will refer to this condition only.

Connect the Television Analyst to the receiver under test and set up and adjust for a proper picture on the TV receiver. Be sure that the horizontal frequency of the Analyst is adjusted to the correct frequency. This is explained in your instruction manual. Turn the color signal on and insert the color bar slide into the Analyst. Adjust video control on the Analyst to get good reproduction of the bars and adjust chroma and hue controls for the proper level of the color signal and that the color bars occur in the proper sequence as shown in Fig. 19. If the color bars do not fall into the proper sequence, the coarse adjustment of the hue range found inside the receiver will center the range of the hue control. At this point it is well to indicate that the horizontal width of the receiver under test should be reduced to be certain that all ten bars are seen.

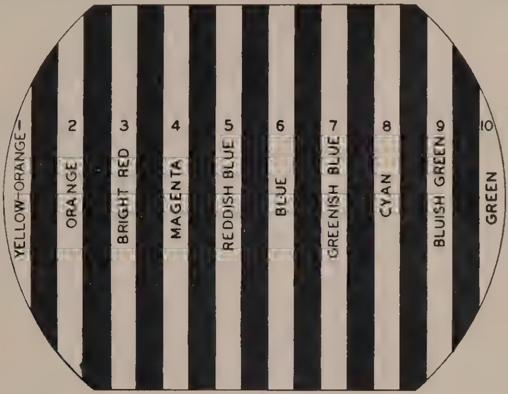


Figure 19—Color bar pattern showing each bar, its number and its color

From fundamental color theory we know that the output of the +(R-Y) demodulator if properly adjusted should have zero +(B-Y) output, and the output of the +(B-Y) demodulator should have zero output of +(R-Y) signal.

Since our color bar pattern has both an +(R-Y) signal which is the third bar, and a +(B-Y) signal which is the sixth bar, we can use these signals to check and align color demodulators.

Connect an oscilloscope of adequate band width to the output of the +(R-Y) demodulator. You will see a waveform similar to that shown in Fig. 20. This is viewed at a 15,750 cycle per second sweep on the oscilloscope. The sixth bar which is +(B-Y) should be at zero amplitude as shown in Fig. 20. If this condition is not met, set the hue control to its center position and adjust the coarse hue control adjusment which is located within the TV receiver so that the sixth bar is at zero amplitude. Now move the oscilloscope to the output of the +(B-Y) demodulator and adjust the quadrature transformer driving the +(B-Y) demodulator so that the third bar which is +(R-Y) is at zero amplitude as shown in Fig. 21.

The color demodulators are now properly aligned so that no +(R-Y) signal gets through the +(B-Y) demodulator, and also no (B-Y), signal gets through the +(R-Y) demodulator. Also the front panel hue control is in the middle of its range to allow variations in both directions if necessary.

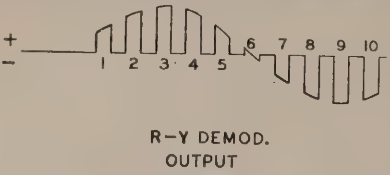


Figure 20—(R-Y) demodulator output as seen on an oscilloscope

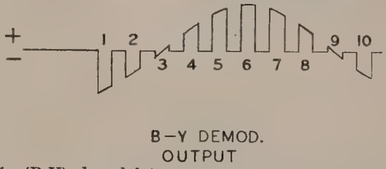


Figure 21—(B-Y) demodulator output as seen on an oscilloscope

This completes the hue control and demodulator adjustments.

HOW TO ADJUST COLOR PURITY AND CONVERGENCE

Adjusting Color TV Purity and Static Convergence

The first adjustment normally made on a color set is purity. It is best to follow the set manufacturers' procedure for purity adjustment. It is, however, most desirable to make this purity adjustment on a blank synchronized raster. This can be accomplished by connecting the generator to the color receiver antenna terminal and tuning in a test pattern, as previously explained. Then remove slide from pattern generator and make purity adjustment on synchronized blank raster.

For static convergence adjustments it is necessary to use the white dot slide supplied with your Television Analyst. The size of the dot supplied by the Analyst has been selected for the most accurate convergence adjustment.

Since static convergence is performed using only the center dot, this dot is surrounded on the Analyst pattern with a series of square dots. This makes it convenient to identify the center dot.

The following procedure is recommended for setting the Analyst to produce a clear, clean dot for use in color convergence.

1. Use the test pattern slide of the Analyst and obtain a good black and white pattern on the color receiver. Keep the RF Attenuator setting as low as possible when making this adjustment.
2. Remove the test pattern slide and insert the dot slide. Readjust the brightness and contrast controls on the receiver to get the proper dot display. Use as low a brightness level as possible on the television receiver to keep the dot from blooming and becoming enlarged. It may be necessary to slightly increase the video output of the Analyst. Excessive video level on the Analyst will also cause the spot to bloom. Improper adjustment of the brightness and contrast control of the receiver or improper adjustment of the video control on the Analyst may result in an unstable dot pattern and blurred dots. It must be emphasized again that the brightness level of the television set must be as low as possible to prevent defocusing of the dot.

Since static convergence is primarily concerned with the center dot, the serviceman must make his adjustments to this dot. Figure 22 in the instruction manual show the motion of the red, green and blue dots which the static convergence magnets will produce. Careful adjustment of the static convergence magnets will cause the three dots to superimpose and become white. If when the three dots (red, green and blue) are separated with the static convergence magnets they appear of unequal size, reduce the background or screen control associated with the larger dot, or dots, until the size of all three dots are approximately equal. When static convergence is then accomplished the center dot will be white. Color fringing may appear on the other dots on the face of the color television set and this then indicates that dynamic convergence adjustments are required.

Since each step of convergence requires that the entire procedure be properly completed, the purity of the receiver must be correct as explained above.

Dynamic Convergence Adjustments

After purity and static convergence adjustments are made, you are then ready to make dynamic convergence adjustments. Insert the white-line slide in the generator. Be sure to set horizontal to correct frequency as explained previously. It is of utmost importance in color convergence that the horizontal frequency is adjusted accurately.

If horizontal frequency tends to drift a few cycles, as noted by a slight vertical movement of the horizontal lines, it can be stabilized by a slight adjustment of the HORIZONTAL control.

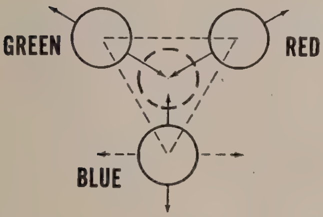


Figure 22—Direction of dot movement for static convergence

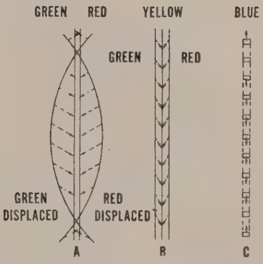


Figure 23—Dot motion due to adjustment of vertical phase and amplitude controls

STEP A—*Preliminary Adjustment*

1. Turn the blue horizontal (parabola or sine-wave) amplitude control to maximum.
2. Adjust the blue horizontal (parabola or sine-wave) phase so that the dip in the horizontal blue bar appears in the center of the horizontal axis of the raster.
3. Re-adjust the blue horizontal (parabola or sine-wave) amplitude to produce a reasonable straight horizontal bar along the horizontal axis of the raster.

STEP B—*Setup of the Vertical Convergence Controls (See Figure 23).*

1. Adjust the red vertical parabola amplitude and phase control to make the red vertical bar, along the vertical axis of the raster, parallel or coincident with the associated blue bar.
2. Adjust the blue vertical parabola amplitude and phase controls to make the horizontal blue bars, along the vertical axis of the raster, equally spaced or coincident with their associated horizontal red bars. (Since the horizontal convergence has not been completely set up, the associated red and blue horizontal bars will not necessarily appear parallel to each other).
3. Adjust the green vertical parabola amplitude and phase controls to make the vertical green bar parallel or coincident with the associated red bar along the vertical axis of the raster. (IF STEP B, (1) was set up properly, the red and green vertical bars will be parallel and the red and green horizontal bars along the vertical axis of the raster will be equally spaced. If these conditions do not exist, STEP B, (1) and (3) should be repeated).
4. Insert white dot slides in pattern generator and statically converge the three dots in the center of the raster.

STEP C—*Setup of the Horizontal Convergence Controls* (See Figure 24).

1. Insert white line slide in Television Analyst.

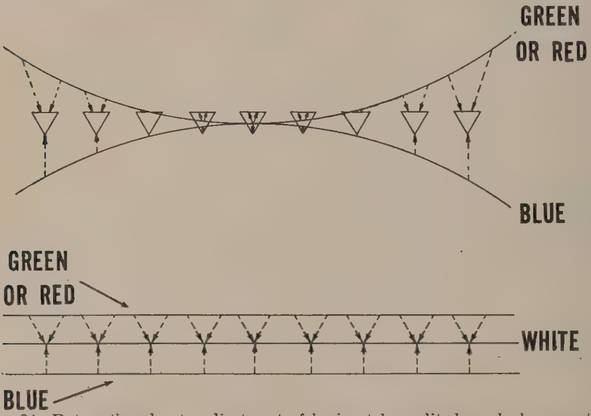


Figure 24—Dot motion due to adjustment of horizontal amplitude and phase controls

2. Adjust the red horizontal (parabola or sine-wave) amplitude and phase controls to make the vertical red bars across the horizontal axis of the raster equally spaced or coincident with the vertical blue bars.
3. Adjust the blue horizontal (parabola or sine-wave) amplitude and phase control to make the blue bar, along the horizontal axis of the raster, parallel or coincident with the associated red bar.
4. Adjust green horizontal (parabola or sine-wave) amplitude and phase controls to make the vertical green bars, along the horizontal axis of the raster, equally spaced or coincident with the associated red bars. (If STEP C, (2) was properly set up, the associated red and green vertical and horizontal bars will be parallel or coincident. If these conditions cannot be obtained, repeat STEP C, (2) and (4).

STEP D—Insert white dot slide and statically converge the dots in the center of the raster.

OTHER USES FOR THE TELEVISION ANALYST

1. *Displaying Your Own Pictures and Patterns on Any TV Receiver*

The Television Analyst will transmit any positive and transparent picture or pattern. The only requirement is that the size of the pattern be limited to 3-by-4-inches. Hence, any pattern drawn with a black crayon on a piece of clear plastic or acetate the same size as the slides furnished with the instrument can be used in the slide-holder. One blank acetate slide is provided with the instrument. Be sure crayon side of slide is facing away from CRT tube. To display black-and-white photos on a TV receiver, merely have a positive film transparency made and use it in the slide-holder. For best results, the film transparency should be enlarged or reduced so that the picture area is about 3-by-4 inches. The full size of the film transparency should be 4⅞" x 6½" in order to fit properly.

2. *Adjusting Linearity and Size*

Connect Television Analyst to antenna terminal of receiver under test. Adjust generator to obtain test pattern of good contrast. Adjust vertical size and linearity of the TV receiver so that outer circle of the test pattern just fills the vertical height of the picture tube. Adjust horizontal size and linearity for as round a circle as possible. It may be necessary to re-adjust receiver vertical height and linearity after horizontal adjustments. The center of the test pattern should coincide with the center of the receiver picture tube. Adjustments of receiver centering controls will accomplish this.

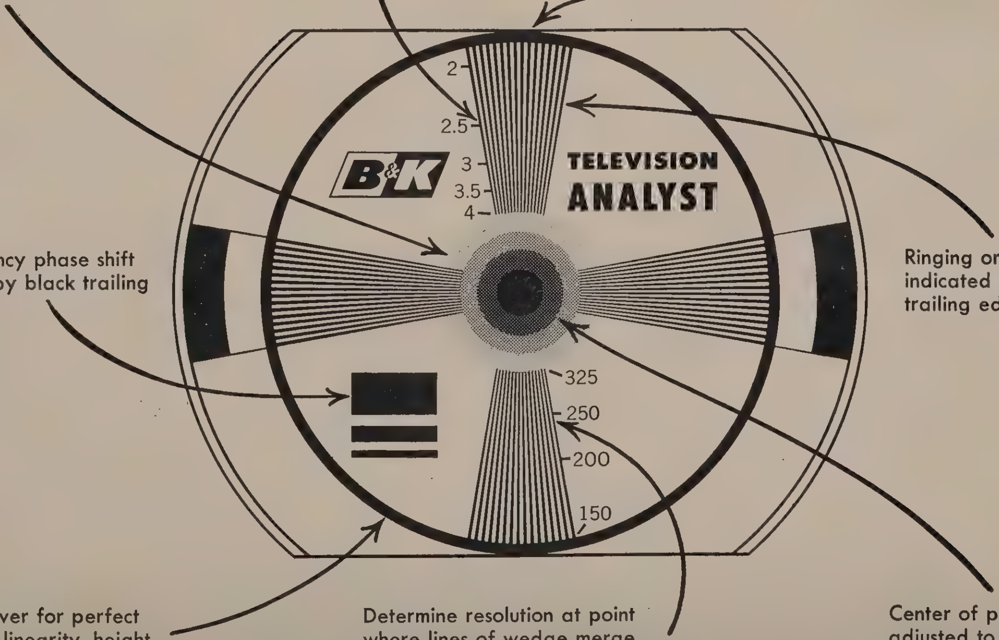
3. *Checking Receiver Resolution*

Connect Television Analyst to the receiver under test. Set channel selector of TV Analyst to an unused channel. Set fine tuning of receiver to obtain a picture display of the best resolution. Adjust VIDEO control of Analyst for good contrast and shading. By observing the resolution wedges on the test pattern (See Fig. 25) one can determine the resolution of the receiver under test. The number of lines of resolution can be read from the test pattern by observing the point at which the lines in the wedges blend together. An average receiver should show approximately 250 lines of horizontal resolution, which is read from the vertical wedge in the test pattern. Any receiver that shows substantially less than 250 lines might be an indication that the receiver requires realignment. The Television Analyst signal when displayed at video through a good video monitor will reproduce a pattern of approximately 400 lines of resolution.

4. *Using the Television Analyst for Display Purposes*

To use the Analyst to display pictures on a number of TV sets, connect its output to the input of the master antenna amplifier through a suitable matching network. Adjust the CHANNEL SELECTOR control for a good picture on the display sets, on an unused channel. Set the R.F. ATTENUATOR so that overloading of the master antenna amplifier does not occur. Set the HORIZONTAL control for a stable picture. Set the VIDEO Control for best picture contrast. After these initial adjustments, only the VIDEO control will have to be adjusted for the different slides which may be used.

If the harmonics or fundamentals of the VHF oscillator interfere with a local station in the area, it may be necessary to use a high pass or low pass absorption filter to eliminate the interference. For example, if the Analyst is set to a channel below Channel 7 and interference occurs at Channel 7 or above, connect the output of the TV Analyst to the input of the filter and take the signal out of the low-band (channels 2 through 6) terminals of the filter.



Shading or gamma check. Shaded areas provide good check for video amplifier linearity.

Determine frequency response at point where lines of wedge merge. Bandwidth shown in megacycles.

To set proper size set top and bottom of circle to top and bottom edges of receiver screen.

Low frequency phase shift evidenced by black trailing smear.

Ringing or overshoot indicated by white trailing edges.

Adjust receiver for perfect circle to set linearity, height, and width.

Determine resolution at point where lines of wedge merge. Resolution shown in number of lines.

Center of pattern should be adjusted to be at physical center of receiver screen.

Figure 25—Test Pattern

All harmonics above Channel 6 will be absorbed by the filter, thus eliminating the high-band interference. Likewise, if the generator is set for a channel above Channel 6 and interference occurs at Channel 6 or below, use the filter and take the output from the high-band (Channels 7 through 13) terminals.

5. *Using the Television Analyst as a Video System Transmitter*

Operate the Television Analyst as directed under "Displaying Your Own Pictures." Write or type the names of the persons being paged on a transparent piece of acetate. To type on the acetate, shift the lever on your typewriter to position where ribbon is not used. Take 2 pieces of good quality carbon paper and insert acetate between them so carbon surfaces are against the front and back of acetate. Put in typewriter and type message in area 3-by4-inches. The clear slide provided has this area marked off. The acetate may be used again by just wiping the carbon printing off.

THEORY OF OPERATION

The Television Analyst is a complete flying spot scanner Video Signal Generator coupled with a radio frequency transmitter. For the reader's con-

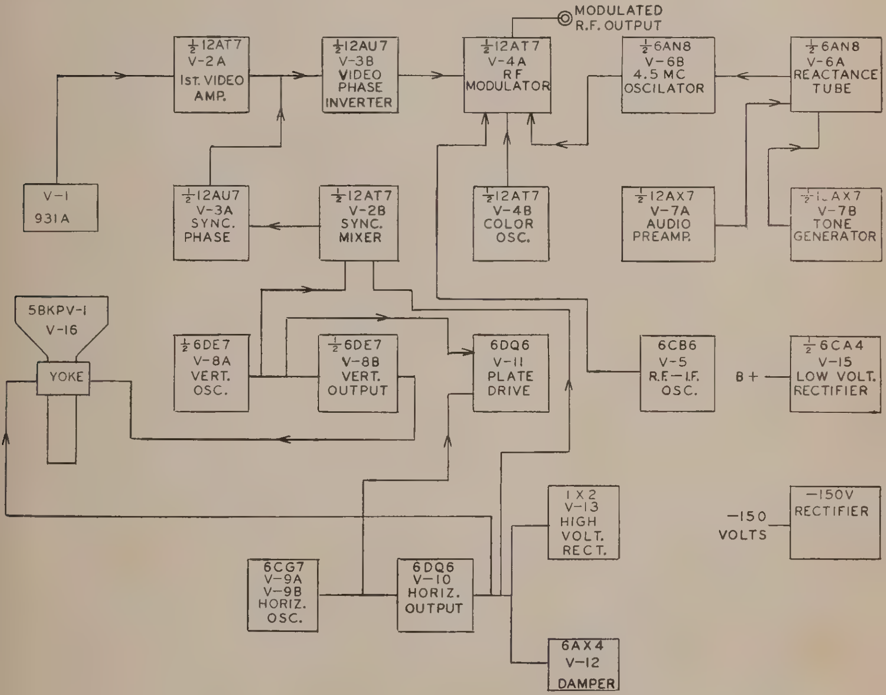

MODULATED R.F. OUTPUT
½ 12AT7 V-2A IST. VIDEO AMP.
½ 12AU7 V-3B VIDEO PHASE INVERTER
½ 12AT7 V-4A RF MODULATOR
½ 6AN8 V-6B 4.5 MC OSCILATOR
½ 6AN8 V-6A REACTANCE TUBE
V-1 931A
½ 12AU7 V-3A SYNC. PHASE
½ 12AT7 V-2B SYNC. MIXER
½ 12AT7 V-4B COLOR OSC.
½ 12AX7 V-7A AUDIO PREAMP.
½ 12AX7 V-7B TONE GENERATOR
5BKPV-1 V-16
YOKE
½ 6DE7 V-8A VERT. OSC.
½ 6DE7 V-8B VERT. OUTPUT
6DQ6 V-11 PLATE DRIVE
6CB6 V-5 R.F.—I.F. OSC.
B +
½ 6CA4 V-15 LOW VOLT. RECTIFIER
1X2 V-13 HIGH VOLT. RECT.
−150 VOLTS
−150V RECTIFIER
6CG7 V-9A V-9B HORIZ. OSC.
6DQ6 V-10 HORIZ. OUTPUT
6AX4 V-12 DAMPER

Figure 26—Block diagram of TV Analyst

venience, a block diagram of the complete instruments is shown in Fig. 26. Many of the circuits in this instrument are quite familiar to the service technician, because they are used in most television receivers. Some of these circuits are new and greater emphasis will be placed upon the description of these circuits.

The Scanning System

The first of these circuits pertains to the conversion of light energy to electrical energy. Certain materials have the ability to emit electrons when they are exposed to light, much the same as the cathode of a conventional electron tube does when it is heated. These materials are known as photoemissive materials. When a photoemissive material is used as the cathode of a diode, any light striking the tube will cause the cathode to emit electrons. These electrons, flowing through the diode load resistor, cause a voltage to be developed across the resistor. Such a tube is shown in front of a transparent slide in Figure 27.

As the small spot of light from the cathode-ray tube sweeps across the slide from left to right, light energy passes through the transparent portions of the slide. When the spot passes behind parts of the opaque "A" painted on the slide, the pattern blocks the light energy. Therefore, during some parts of the spot's sweep across the slide, light energy strikes the photoemissive cathode of the photo tube, while at other times it does not. This energy develops a varying voltage across the load resistor. Thus, part of the "A" on the slide has been changed to an electrical signal, as shown in Figure 27. As illustrated, when light energy is transmitted through the transparent portion of the slide, a voltage is developed across the resistor, and when the "A" blocks the light, no voltage is measured.

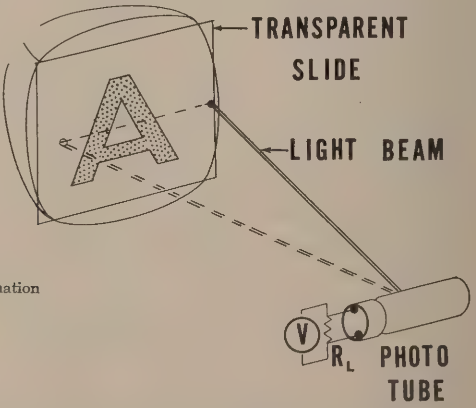


Figure 27—Changing Video Information to an Electric Signal

The cathode-ray, or "scanner" tube used in the Generator is specially designed to match the spectral response of the photomultiplier pickup tube.

As shown in Figure 27, the spot of light produced by the scanner starts at the top of the faceplate, sweeps across to one side, is blanked while it returns to the other side (retraces), sweeps to one side, is blanked while it returns to the other side (retraces), etc., until it finally reaches the bottom of the screen. It is then blanked and returned to the top of the screen. If the "A" of Figures 27 and 28 is placed over the face of the scanner tube, the dot of light and photomultiplier tube translates the entire pattern, spot by spot, into a video signal.

The electrical impulses which have been produced as a result of the light variation on the photomultiplier tube are developed across the photomultiplier load resistor R-102 on your schematic. This is a 1000 ohm resistor.

The video signal is capacity coupled to the grid of V-2A. V-2A is the first video amplifier. In order to improve the high frequency response of the system, inductive peaking is employed in the plate circuit of this tube and R.C. peaking is employed in the cathode circuit. In the plate circuit of V-2A there is a 500 ohm potentiometer which is part of the plate load resistor of V-3A. It is the common coupling between these two stages which mixes the synchronizing information with the video information to produce a composite signal of both sync and video. This signal is present at the plates of V-2A. This composite signal is capacity coupled to the grid of V-3B. Outputs are taken from both plate and cathode of V-3B and appear on the front panel as the video output, either sync positive or sync negative, depending upon whether the polarity reversal switch selects the plate or the cathode circuit. The plate load resistor for V-3B consists of two 470 ohm resistors. The signal present at the junction of the two resistors is capacity coupled to V-4A which is the R. F. modulator. The R.F. modulator receives in the cathode circuit the output of the raido frequency oscillator V-5. Also present at the cathode is the output from the 4.5 mc sound system and the output of the color oscillator. Modulation results in this tube, and the modulated R.F. output is taken from the plate and is capacity coupled to R-29A part of the R.F. Attenuator network. It is at this point that the modulated R.F. signal is available on the front panel.

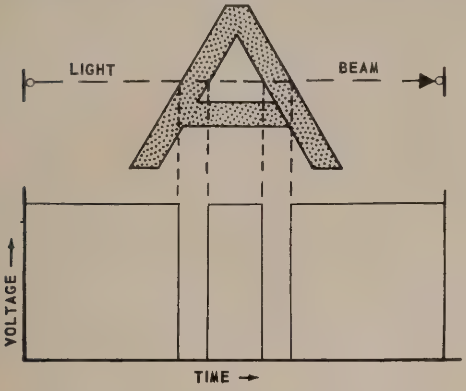


Figure 28—Voltage as Light Beam Moves Across Pattern

Synchronizing information is obtained by mixing a combination of vertical and horizontal signals in V-2B. A few turns of wire which form the secondary of the width coil L-2 provides the cathode return of V-2B. A vertical pulse from the vertical saw generator is applied to the grid of V-2B through suitable filtering to remove horizontal pulses. The mixing is accomplished in the plate circuit of this tube, and at pin 6, the plate, both vertical and horizontal sync information is present. This is capacity coupled to the grid of V-3A where additional amplification and clipping of the sync signal is accomplished. Part of the load resistor of V-3A is common to V-2A. This is the previously mentioned 500 ohm control which is the Sync Level Adjust. A potentiometer is connected from the plate and cathode of V-3A. When the potentiometer is in its center position it is affectively at signal ground an no output will appear at the sync output jack. As the potentiometer R-2 is rotated either clockwise or counter clockwise you will approach either the plate or the cathode signal. This enables the user to acquire either sync positive or sync negative at the output jack by merely rotating the sync amplitude and phase control. V-4B is the crystal controlled color subcarrier oscillator. This oscillator is factory adjusted to a very precise frequency to assure the proper rainbow display or color bar display when used in trouble shooting color television receivers.

The R.F. oscillator circuit V-5 is basically a Colpitis Type oscillator with the tuning inductances switched in by means of a selector switch. Each channel has its own coil and is pre-tuned to the correct frequency. This switch also enables the operator to switch-into the I.F. position the proper coil which resonates with C-17 the I.F. tuning capacitor, thus the instrument is capable of tuning television channels 2, 3, 4, 5, 6, 7, 8, 12 and 13, plus the I.F. range of 20 to 48 mc. In order to obtain smooth R.F. Attenuator action the screen voltage of the oscillator tube is varied at the same time that the R.F. output signal from the modulator is varied. This is accomplished in R-29A and R-29B, a dual potentiometer. The output from the R.F. oscillator is capacity coupled from the plate of V-5 to the cathode of the modulator stage V-4A.

The sound system consists of one half of a 6AN8 4.5 mc oscillator whose output is taken from the cathode of V-6B. The second section of the 6AN8 V-6A is the F.M. reactance tube to provide frequency modulation on the 4.5 mc oscillator. This reactance tube can be driven from two sources, one source is V-1B, one half of a 12AX7. This tube is connected as a phase shift oscillator and produces the 400 cycle internal tone. This tone is also available from a front panel jack. The second section of the 12AX7 is connected as an audio amplifier whose imput can be any source desired such as an external signal generator, F.M. tuner, tape recorder, microphone, etc. The minimum signal requirements for full modulation at this audio input is approximately 30 millivolts.

We will now turn our attention to the vertical deflection system. This deflection system consists of a neon lamp NE-2L and 6RE7 twin triode. The Television Analyst is synchronized directly to the 60 cycle power line and this is accomplished in the following manner. A high level signal taken from one side of the high voltage winding of the power transformer is fed into NE-2L. This lamp will not conduct until approximately 65 volts appears across it. Therefore, the sine wave introduced from the A.C. line from the power transformer is effectively clipped into a square wave whose peak to peak amplitude is approximately 130 volts. This signal is then used to key one half of the 6BE7, V-8A, into conduction. This allows capacitor C-204 to discharge through the tube and then during the scanning interval V-8A is cut off due to grid leak bias, and C-204 will again charge. When the keying pulse comes along to drive V-8A into conduction C-204 discharges during the retrace interval. The saw tooth signal thus acquired as capacity coupled into R-207 the vertical size control to the grid of the vertical output stage. The vertical output stages consists of the second half of V-8B. Vertical linearity it accomplished by adjusting the cathode resistance by means of R-206 the vertical linearity control. The transformer in the plates of V-8B matches the impedance between the vertical output tube and the deflection yoke. No vertical hold control is required since the vertical oscillator system is keyed directly from the A.C. line.

The horizontal deflection system consists of V-9 a 6CG7 connected as a cathode coupled multi-vibrator employing sine wave stabilization. The stabilizing network consists of L-201 the ringing coil tuned with a .005 mfd capacitor, making this network resonant to 15,750 cycles. Since L-201 is a relatively high "Q" device it exercises major control in establishing and maintaining the frequency of the oscillator. It is this coil which accounts for the excellent long term stability of the horizontal circuit. Two horizontal frequency adjustments are provided. One of them being R-11 the fine horizontal frequency which is a front panel control, and R-211 the coarse horizontal frequency control which is an auxillary adjustment located within the instrument. The saw tooth waveform developed as a result of the charge and discharge of C-216 is capacity coupled to the grid of the horizontal output stage. A horizontal drive control is provided and is of the series type. Maximum capacity, representing maximum drive to the horizontal output system. The horizontal output transformer and high voltage circuits are conventional and are the auto transformer type using a 6AX4, V-12, as the damper tube, and a 1X2, V-13, as the high voltage rectifier. The recovered high voltage from this system is approximately 12.5 kv at a 75 microampere load. A width coil is employed to control the horizontal scan that is shunted across a portion of the horizontal output transformer winding. A tap from this same transformer is capacity coupled to the front panel and is used as the high level A.G.C. keying pulse. V-11, a 6BQ6, is used for both vertical and horizontal plate drive. Examination of the plate drive selector switch will show that one section of the switch is used to choose between a vertical saw driving signal and a horizontal saw driving signal, both of them obtained from their respective oscillators. The second section of the switch is used to establish the proper bias for the 6DQ6 for both the vertical and horizontal position. The neutral position is off which opens the cathode of this tube, disconnecting it completely.

The next section under consideration is the horizontal output transformer and yoke shorted turns tester. This is a relatively simple circuit based on a pulse oscillator that is sensitive to inductance and "Q". The bias that is developed from this oscillator is fed to V-14A, a DC amplifier, which operates the test indicator neon lamp. Since shorted turns in yokes and flybacks most readily manifest themselves as a reduction in "Q" and since the oscillator circuit is sensitive to change in "Q" a bias voltage change is encountered which causes the DC amplifier V-14 to draw current and turn on the test indicator lamp. The change in "Q" reflected by a horizontal output transformer with as little as one single shorted turns is sufficient to disrupt the oscillator V-14B and cause the test indicator to light.

The power supply is very conventional. V-15, a 6CA4, is a low voltage rectifier. You will note that the cathode is fused with a ¼″ fuse which protects the complete power supply from overload due to a short anywhere in the chassis. The filter consists of C-12A and C-12B and R-34 a 220 ohm resistor. This supplies the 200 volts DC required for operation of the chassis. A +175 volt point is acquired for operation of the video system by dropping and de-coupling through R-17 and C-12C. A tap on the power transformer provides a 117 volts AC signal to the selenium rectifier SR-1. The negative 150 volts thus developed is applied to the cathode of the photomultiplier tube. A tap on the voltage divider from this point to ground which is the sync level calibrate control, R-15, adjusts the total voltage appearing across V-3A the sync output stage. A second potentiometer in the voltage divider, R-16,, a 10K potentiometer, provides the calibrated negative bias appearing on the front panel of the instrument. The power supply also incorporates an Off-Stand-by-On switch. When in "Stand-by" position, heater power only is supplied to all tubes. When switched to the "On" postion, B+ is applied so that the instrument is ready for operation merely at the flip of a switch. It might be well to mention at this point that B+ boost which is derived from the horizontal deflection system is used to power the photomultiplier tube plate, and B+ boost is also used to drive the vertical saw generator stage. B+ boost is also used as a source of first anode voltage on the 5BKPV1 scanning tube. This higher voltage results in improved focus and spot size of the scanning tube which in turn will result in improved resolution. The vertical blanking signal for the 5BKPV1 scanning tube is derived from the vertical saw maker and is applied to the control grid of the scanning tube. The horizontal blanking information is derived from the cathode of V-3A the sync output stage that is capacitor coupled to the cathode of the scanning tube. This completes the circuit description of the Television Analyst.

SERVICE ADJUSTMENTS

The following section will deal with the method of adjusting the various auxiliary controls contained in the Television Analyst. Locations of these controls can be found by raising the cover. A tube and control layout diagram is located on the inside of this cover.

THE SYNC LEVEL control R-121, is adjusted in the following manner. An oscilloscope is connected from pin 2 to ground of V-4A the R.F. modulator. R-121 is adjusted for .35 volts peak to peak of sync signal. This is done with the video gain control turned to minimum.

COLOR OSCILLATOR adjust. Capacitor C-114 is preset at the factory and will probably not require adjustment throughout the life of the instrument. This applies even when V-4 is replaced. If re-adjustment of this control is necessary, it must be adjusted to set the frequency of the crystal oscillator to 3.563795 mc to an accuracy of .001 percent.

SYNC LEVEL CALIBRATE. This control determines the calibration of the sync amplitude output control and is adjusted in the following manner. With an oscilloscope connected to the sync output jack and the sync amplitude control set to either —50 or +50 resistor R-215 is adjusted for 50 volts peak to peak of sync information on the oscilloscope.

HORIZONTAL OSCILLATOR adjustments. There are three adjustments required to properly set the horizontal oscillator. They are the horizontal frequency fine, the horizontal frequency coarse and L-201 the ringing coil. To adjust proceed as follows. Short out L-201 with a jumper lead. Set horizontal frequency fine which is the front panel control to #5 on the calibrated dial. Adjust R-211 the coarse horizontal frequency adjustment so that the oscillator is running at exactly 15,750 cycles. A convenient method to do this is to superimpose on a television receiver a picture from a TV station and the picture from the Television Analyst. This can be most easily accomplished by having the TV receiver tuned to one channel and the Television Analyst tuned to the adjacent channel. By adjustment of the R.F. Attenuator the picture from the Television Analyst can be seen to float by. When the horizontal frequency coarse control is properly adjusted the picture will be standing straight up and thus floating by either to the right or to the left. When this has been accomplished, remove the short across L-201 and adjust it so that again the picture stands straight up and just floats by. This completes the Horizontal Oscillator adjustments.

LINEARITY SIZE AND CENTERING. The adjustment for these controls are described on page . . under "How to Set Up the Television Analyst."

THE VERTICAL SIZE, VERTICAL LINEARITY, HORIZONTAL SIZE AND HORIZONTAL DRIVE controls are adjusted to provide the best possible vertical and horizontal linearity. The Horizontal Drive control is best adjusted by starting with the trimmer turned four full turns open from its normally closed position. Advance the Horizontal Drive screw down until a drive bar appears and then back off until it just disappears. This will provide the best conditions for Horizontal Linearity.

LEAKAGE CONTINUITY TEST. Calibration is accomplished by placing a 10 megohm resistor between the two leakage continuity jacks and rotating the calibrate control on the front panel to the Leakage Continuity position. R-218 the leakage continuity calibrate control inside the chassis is then adjusted so that the neon lamp just lights.

4.5 mc OSCILLATOR adjustment. The frequency of the 4.5 mc oscillator must be adjusted with the Off-Audio-Tone switch in the "Audio" position. If an accurate 4.5 mc standard oscillator is available, then the two are brought to zero beat. In the absence of a standard oscillator, the following technique can be used. Using a standard TV receiver tuned to a broadcast station, adjust the discriminator circuit for an absolute zero output indicating that the discriminator is tuned correctly. Turn the Television Analyst on and obtain a picture and sound carrier on the TV receiver and adjust L-401 the 4.5 mc oscillator adjustment in the Television Analyst for exactly zero output on the TV receiver discriminator.

R.F.-I.F. OSCILLATOR COILS. These coils are factory adjusted for the correct frequency and should not normally have to be re-adjusted. If the occasion does arise an accurate radio frequency signal of the correct frequency must be available so that the signal from the Television Analyst and this signal can be adjusted for zero beat. It is possible to approximate this adjustment by tuning a TV station of the correct channel in on a TV receiver and feeding the Television Analyst R.F. signal in on the same channel. The video control is turned to zero. The zero beat is then obtained by adjusting the appropriate slug in the Television Analyst until zero beat is visually seen on the receiver screen. To adjust the I.F. coil requires that the I.F. tuning selector be set to 40 mc and the I.F. coil tuned to this frequency using an external unmodulated standard signal generator. The high band channels cover 7 and 8, and 12 and 13. If it is desired to tune one of these channels to a different frequency, the previously outlined method can be used since the range of adjustment of each slug covers approximately two channels. It is also possible to write in pencil on the silver area of the channel selector dial the new channel to which it has been tuned. The matte surface covering this finish permits writing with pencil, and also erasures.

The slugs for the coils of channels 6, 7, 8, 12 and 13 may be reached from the top by inserting an alignment tool (General Cement #8606 or equivalent) through the slug located directly above the coil to be aligned. The hex head of the alignment tool must go completely through the top slug and engage the bottom slug to be tuned. This same alignment tool is used to adjust all other coils in the Analyst.

Beam Current

The Beam Current control (R-201)is adjusted so that the cathode current of the 5BKPV1 is 75 microamperes.

SERVICE INFORMATION

The enclosed schematic contains complete voltage chart and all key waveforms to assist in trouble shooting the Television Analyst.

The instrument contains two fuses. Both are accessible from the top of the instrument and are located just in front of the 5BKPV1 scanning tube. The Line Fuse is a 3 ampere fuse while the B+ fuse is a ¼ ampere slo-blo fuse. Replacements must be made with identical types in order to retain the protection offered by these fuses.

All tubes are accessible from the top of the Analyst and can be replaced without removing the cabinet from the chassis.

All under the chassis components are available by removing the four rubber feet and the two screws holding the perforated bottom plate to the chassis.

If it becomes necessary to remove the cabinet perform the following steps.

1. Remove the three screws at the top of the panel.
2. Remove the screw at the right hand side of the panel located halfway between the top and the bottom of the panel.
3. Remove the screw at the left hand side of the panel located halfway between the top and bottom of the panel. DO NOT REMOVE ANY ADDITIONAL SCREWS FROM THE PANEL.
4. Remove two screws from the right hand side of the case near the bottom of the Analyst.
5. Remove two screws from the left hand side of the case near the bottom of the Analyst.
6. Remove three screws from the rear of the cabinet located near the bottom.
7. Lift off the case.

WARRANTY SERVICE INSTRUCTIONS

1. Refer to the maintenance section of the instruction manual for adjustments that may be applicable.
2. Check common electronic parts such as tubes and batteries. Always check instruction manual for applicable adjustments after such replacement.
3. Defective parts removed from units which are within the warranty period should be sent to the factory prepaid with model and serial number of instrument from which removed and date of instrument purchase. These parts will be exchanged at no charge.
4. If the above mentioned procedures do not correct the difficulty, pack the instrument securely (preferably double packed). A detailed list of troubles encountered must be enclosed as well as your name and address. Forward prepaid (express preferred) to the nearest B&K authorized service agency.

Contact your local B&K Distributor for the name and location of your nearest service agency, or write to

Service Department
B&K MANUFACTURING COMPANY
DIVISION OF DYNASCAN CORPORATION
1801 W. Belle Plaine
Chicago 13, Ill.

WARRANTY

"B & K warrants that each instrument manufactured by it will be free from defects in material and workmanship under normal usage and service for a period of ninety days after its purchase new from an authorized B & K distributor. Our obligation under this warranty is limited to repairing, or replacing any instrument or component which we are satisfied does not conform with the foregoing warranty and which is returned to our factory or our authorized service contractor, transportation prepaid, and we shall not otherwise be liable for any damages, consequential or otherwise. *The foregoing warranty is exclusive and in lieu of all other warranties (including any warranty of merchantability), whether express or implied.* Such warranty shall not apply to any instrument or component (i) repaired or altered by anyone other than B & K or its authorized service contractor (except normal tube replacement) without B & K's prior written approval; (ii) tampered with or altered in any way or subjected to misuse, negligence or accident; (iii) which has the serial number altered, defaced or removed; or (iv) which has been improperly connected, installed or adjusted otherwise than in accordance with B & K's instructions. B & K reserves the right to discontinue any model at any time or change specifications or design without notice and without incurring any obligation. *The warranty shall be void and there shall be no warranty of any instrument or component if a B & K warranty registration card is not properly completed and postmarked to the B & K factory within five days after the purchase of the instrument new from an authorized B & K distributor."*

B & K MANUFACTURING COMPANY
DIVISION OF DYNASCAN CORPORATION
1801 W. BELLE PLAINE AVE. • CHICAGO, 13

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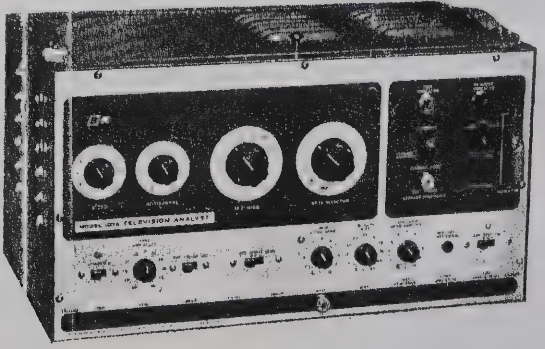
TELEVISION ANALYST

Model 1076

INSTRUCTION MANUAL



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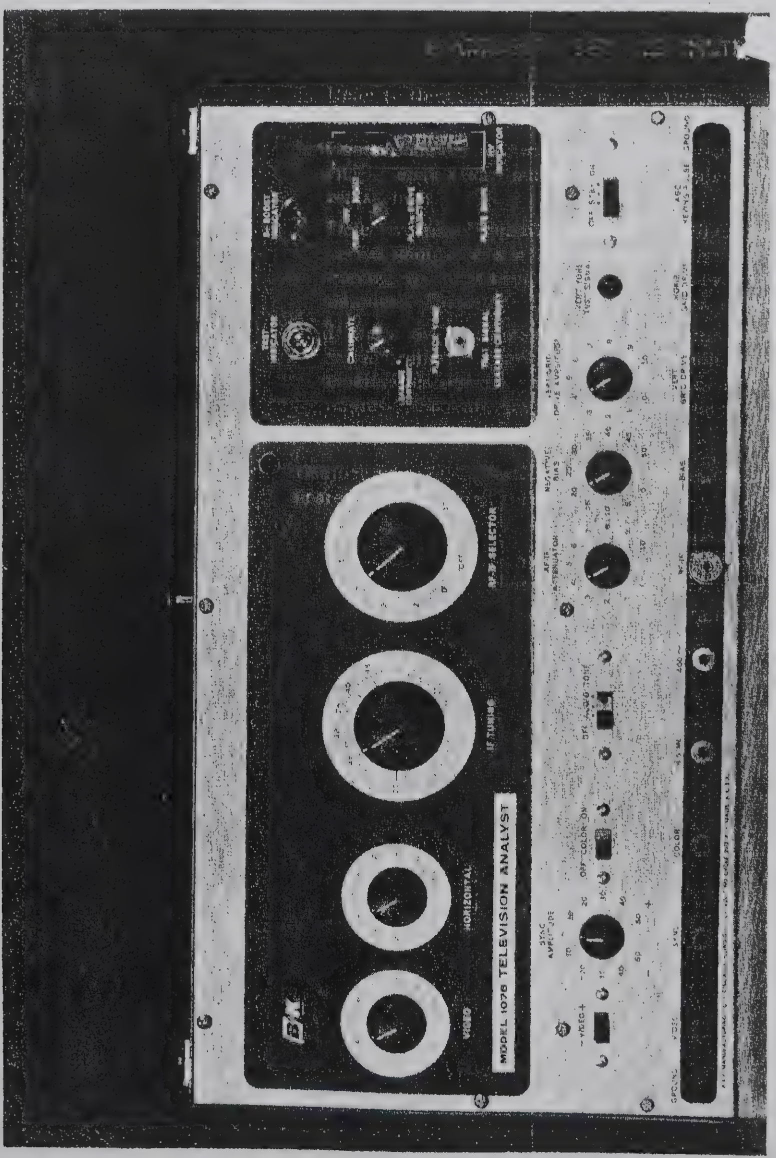

Figure 1. — Front Panel Controls

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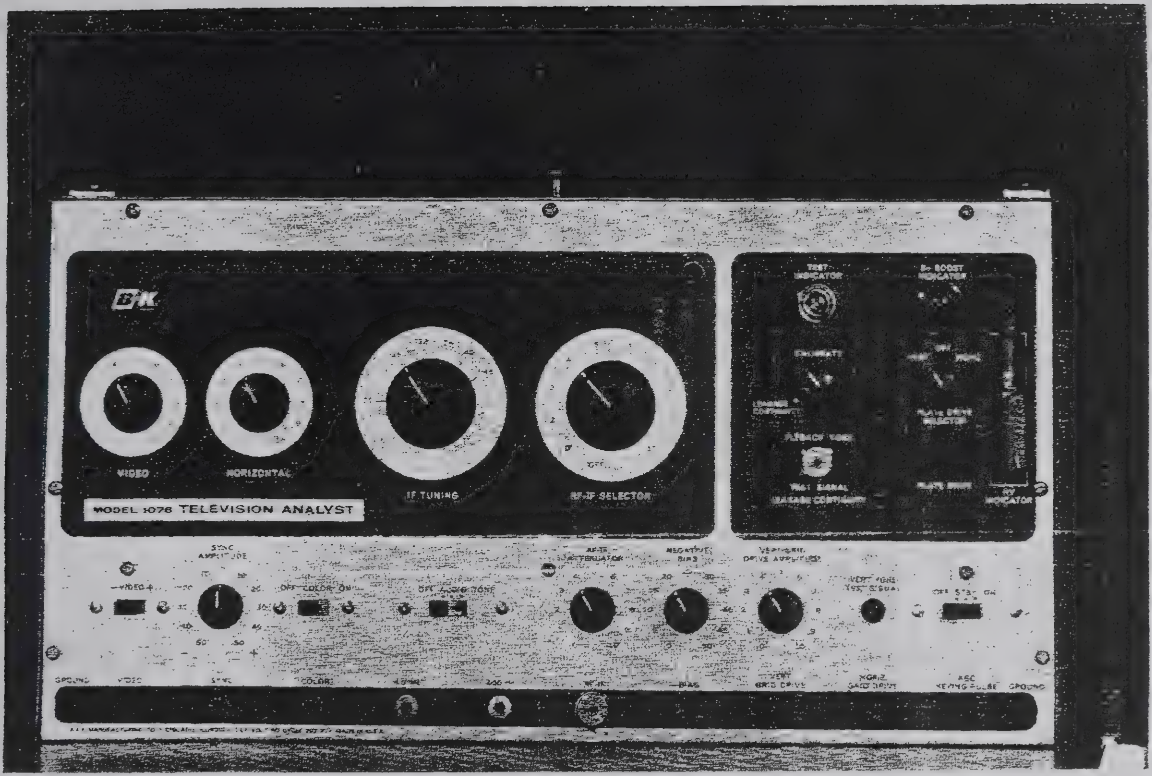

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INSTRUCTION MANUAL

FOR

Model 1076

TELEVISION ANALYST

B & K MANUFACTURING COMPANY
DIVISION OF DYNASCAN CORPORATION
1801 West Belle Plaine Avenue
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HORIZONTAL OSCILLATOR adjustments. There are three adjustments required to properly set the horizontal oscillator. They are the horizontal frequency fine, the horizontal frequency coarse and L-201 the ringing coil. To adjust proceed as follows. Short out L-201 with a jumper lead. Set horizontal frequency fine which is the front panel control to #5 on the calibrated dial. Adjust R-211 the coarse horizontal frequency adjustment so that the oscillator is running at exactly 15,750 cycles. A convenient method to do this is to superimpose on a television receiver a picture from a TV station and the picture from the Television Analyst. This can be most easily accomplished by having the TV receiver tuned to one channel and the Television Analyst tuned to the adjacent channel. By adjustment of the R.F. Attenuator the picture from the Television Analyst can be seen to float by. When the horizontal frequency coarse control is properly adjusted the picture will be standing straight up and thus floating by either to the right or to the left. When this has been accomplished, remove the short across L-201 and adjust it so that again the picture stands straight up and just floats by. This completes the Horizontal Oscillator adjustments.

LINEARITY SIZE AND CENTERING. The adjustment for these controls are described on page . . under "How to Set Up the Television Analyst."

THE VERTICAL SIZE, VERTICAL LINEARITY, HORIZONTAL SIZE AND HORIZONTAL DRIVE controls are adjusted to provide the best possible vertical and horizontal linearity. The Horizontal Drive control is best adjusted by starting with the trimmer turned four full turns open from its normally closed position. Advance the Horizontal Drive screw down until a drive bar appears and then back off until it just disappears. This will provide the best conditions for Horizontal Linearity.

LEAKAGE CONTINUITY TEST. Calibration is accomplished by placing a 10 megohm resistor between the two leakage continuity jacks and rotating the calibrate control on the front panel to the Leakage Continuity position. R-218 the leakage continuity calibrate control inside the chassis is then adjusted so that the neon lamp just lights.

4.5 mc OSCILLATOR adjustment. The frequency of the 4.5 mc oscillator must be adjusted with the Off-Audio-Tone switch in the "Audio" position. If an accurate 4.5 mc standard oscillator is available, then the two are brought

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MODEL 1076 TELEVISION ANALYST

What The Model 1076 Television Analyst Will Do:

Some idea of the versatility of the Model 1076 Television Analyst can be gained from a quick check of the following list of major equipment features and uses.

1. As a signal generating source for point-to-point signal injection trouble shooting techniques throughout a complete TV receiver.
2. Will supply complete (video and audio) R.F. and I.F. signals to quickly trouble shoot these sections of TV receivers.
3. Will supply a complete test pattern at video (either sync positive or negative) to inject signal into video stages of TV receivers.
4. Provides a 4.5 mc sound channel, F.M. modulated with approximately 25 KC deviation. This audio carrier is modulated from either a built-in 400 cycle tone generator, or any external audio source.
5. Provides a 400 cycle audio tone signal for signal injection.
6. Separate vertical and horizontal driving pulses are available for injecting for trouble shooting sweep circuits.
7. Provides composite synchronizing signals either sync negative or sync positive, adjustable in amplitude, to troubleshoot sync circuits.
8. Provides vertical output stage plate drive signal to check vertical output transformer, and yoke.
9. Provides vertical yoke test signal to determine if vertical yoke windings are defective.
10. Provides horizontal driving signal to drive horizontal output transformer directly in a TV receiver.
11. Provides B+ boost indicator.
12. Provides hi-voltage indicator.
13. Provides sensitive leakage and continuity test for horizontal output transformer and yoke.
14. Provides sensitive test to determine if horizontal output transformer or yoke have internal shorted turns.
15. Provides a high level A.G.C. keying pulse for substitution in keyed A.G.C. systems.
16. Provides high level test signal to directly modulate TV picture tubes.
17. Built in calibrated low impedance negative bias supply.
18. As a white dot and cross-hatch generator for color TV convergence adjustments.
19. To trouble shoot and signal trace color circuits in a color TV receiver. Generates color rainbow pattern and color bar pattern.
20. By the use of the test pattern, TV receivers can be checked for bandwidth, resolution, shading and contrast capabilities.
21. Checks the R.F. sensitivity and A.G.C. settings of TV receivers.
22. To check and adjust the vertical and horizontal linearity, size and aspect ratio of TV receivers.
23. As a stable signal source for trouble shooting intermittents.
24. Will reproduce any 3" x 4" positive transparency as a picture source to demonstrate the performance capabilities of TV receivers.
25. As an advertising medium to display both picture and sound messages on the screens of TV receivers in department and retail stores.
26. As the transmitter for video and audio paging systems at conventions, hospitals and other gatherings.
27. To check performance of community and master antenna systems.

CONTROLS: WHAT THEY DO

Main Controls

The following main operating controls are provided on the front panel of the Model 1076 Television Analyst. (See Figure 1).

1. POWER SWITCH. This Switch is labeled Off-Stby-On, and permits the unit to be kept at readiness by using the Stand-by position to keep the tubes hot, yet prevents any radiation of signal from the unit. The pilot light will light in either the "Stby" or "On" position.
2. R.F. - I.F. SELECTOR SWITCH. By means of this Switch the Television Analyst can be tuned to channels 2 through 6, 7, 8, 12 or 13. When switched to the I.F. position the unit will transmit on I.F. Both R.F. and I.F. frequency generators are turned off in the "Off" position of the R.F. Selector Switch.
3. I.F. TUNING. This control enables the Television Analyst to tune any I.F. frequency between 20 mc and 48 mc.
4. VIDEO CONTROL. This Control is used to determine the amount of Video or contrast of the picture.
5. HORIZONTAL CONTROL. This Control is a fine frequency adjustment of the horizontal oscillator circuit in the Analyst.
6. VIDEO POLARITY (+ or –) SWITCH. This Switch determines whether the Video output signal will be of a positive or negative polarity. The positive polarity indicates positive going sync pulses; negative polarity indicates negative going sync pulses.
7. SYNC AMPLITUDE CONTROL. This Control adjusts the amplitude and phase of the sync signal available from the Sync Output jack. This control is calibrated in peak to peak volts for both sync positive and sync negative. Clockwise rotation results in positive sync. Counter-clockwise rotation results in negative sync.
8. COLOR OFF-ON SWITCH. This Switch is used to turn on the color signal for a color rainbow or color bar display.
9. AUDIO SWITCH. The Audio Switch is labeled "Off-Audio-Tone". In the "Off" position there is no audio signal being transmitted. In the "Audio" position, any external source of audio can be used to modulate the audio carrier. This source can be anything from .01 to 5 volts such as a microphone, F.M. tuner, record player, tape recorder, etc. The "Tone" position of this switch turns on an internal 400 cycle audio oscillator which is used to modulate the F.M. carrier. This tone can also be obtained at the 400 cycle output jack.
10. R.F. ATTENUATOR. The R.F. Attenuator Control determines the amount of signal output of both R.F. and I.F. frequencies. At R.F. this control should normally be set at mid-range.
11. NEGATIVE BIAS CONTROL. This calibrated Control enables the operator to select a negative voltage to ground, between 0 and 50 volts.
12. VERTICAL DRIVE AMPLITUDE. This Control adjusts the amplitude of both the vertical grid drive signal and the vertical plate drive signal.
13. PLATE DRIVE SELECTOR. This three position Switch provides a choice of a Vertical plate drive signal or a Horizontal plate drive signal to directly drive a horizontal output transformer. The third position is Off. When not using plate drive, this Switch should be in "Off" position, or tearing in the picture might occur.

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capacity coupled to the grid of the horizontal output stage. A horizontal drive control is provided and is of the series type. Maximum capacity, representing maximum drive to the horizontal output system. The horizontal output transformer and high voltage circuits are conventional and are the auto transformer type using a 6AX4, V-12, as the damper tube, and a 1X2, V-13, as the high voltage rectifier. The recovered high voltage from this system is approximately 12.5 kv at a 75 microampere load. A width coil is employed to control the horizontal scan that is shunted across a portion of the horizontal output transformer winding. A tap from this same transformer is capacity coupled to the front panel and is used as the high level A.G.C. keying pulse. V-11, a 6BQ6, is used for both vertical and horizontal plate drive. Examination of the plate drive selector switch will show that one section of the switch is used to choose between a vertical saw driving signal and a horizontal saw driving signal, both of them obtained from their respective oscillators. The second section of the switch is used to establish the proper bias for the 6DQ6 for both the vertical and horizontal position. The neutral position is off which opens the cathode of this tube, disconnecting it completely.

The next section under consideration is the horizontal output transformer and yoke shorted turns tester. This is a relatively simple circuit based on a pulse oscillator that is sensitive to inductance and "Q". The bias that is developed from this oscillator is fed to V-14A, a DC amplifier, which operates the test indicator neon lamp. Since shorted turns in yokes and flybacks most readily manifest themselves as a reduction in "Q" and since the oscillator circuit is sensitive to change in "Q" a bias voltage change is encountered which causes the DC amplifier V-14 to draw current and turn on the test indicator lamp. The change in "Q" reflected by a horizontal output transformer with as little as one single shorted turns is sufficient to disrupt the oscillator V-14B and cause the test indicator to light.

The power supply is very conventional. V-15, a 6CA4, is a low voltage rectifier. You will note that the cathode is fused with a ¼″ fuse which protects the complete power supply from overload due to a short anywhere in the chassis. The filter consists of C-12A and C-12B and R-34 a 220 ohm resistor. This supplies the 200 volts DC required for operation of the chassis. A +175 volt point is acquired for operation of the video system by dropping and de-coupling through R-17 and C-12C. A tap on the power transformer provides a 117 volts AC signal to the selenium rectifier SR-1. The negative 150 volts thus developed is applied to the cathode of the photomultiplier tube. A tap on the voltage divider from this point to ground which is the sync level calibrate control, R-15, adjusts the total voltage appearing across V-3A the sync output stage. A second potentiometer in the voltage divider, R-16,, a 10K potentiometer, provides the calibrated negative bias appearing on the front panel of the instrument. The power supply also incorporates an Off-Stand-by-On switch. When in "Stand-by" position, heater power only is supplied to all tubes. When switched to the "On" postion, B+ is applied so that the instrument is ready for operation merely at the flip of a switch. It might be well to mention at this point that B+ boost which is derived from the horizontal deflection system is used to power the photomultiplier tube plate, and B+ boost is also used to drive the vertical saw generator stage. B+ boost is also used as a source of first anode voltage on the 5BKPV1 scanning tube. This higher voltage results in improved focus and spot size of the scanning tube which in turn will result in improved resolution. The vertical blanking signal for the 5BKPV1 scanning tube is derived from the vertical saw maker and is applied to the control grid of the scanning tube. The horizontal blanking information is derived from the cathode of V-3A the sync output stage that is capacitor coupled to the cathode of the scanning tube. This completes the circuit description of the Television Analyst.

output jack by merely rotating the sync amplitude and phase control. V-4B is the crystal controlled color subcarrier oscillator. This oscillator is factory adjusted to a very precise frequency to assure the proper rainbow display or color bar display when used in trouble shooting color television receivers.

The R.F. oscillator circuit V-5 is basically a Colpitis Type oscillator with the tuning inductances switched in by means of a selector switch. Each channel has its own coil and is pre-tuned to the correct frequency. This switch also enables the operator to switch-into the I.F. position the proper coil which resonates with C-17 the I.F. tuning capacitor, thus the instrument is capable of tuning television channels 2, 3, 4, 5, 6, 7, 8, 12 and 13, plus the I.F. range of 20 to 48 mc. In order to obtain smooth R.F. Attenuator action the screen voltage of the oscillator tube is varied at the same time that the R.F. output signal from the modulator is varied. This is accomplished in R-29A and R-29B, a dual potentiometer. The output from the R.F. oscillator is capacity coupled from the plate of V-5 to the cathode of the modulator stage V-4A.

The sound system consists of one half of a 6AN8 4.5 mc oscillator whose output is taken from the cathode of V-6B. The second section of the 6AN8 V-6A is the F.M. reactance tube to provide frequency modulation on the 4.5 mc oscillator. This reactance tube can be driven from two sources, one source is V-1B, one half of a 12AX7. This tube is connected as a phase shift oscillator and produces the 400 cycle internal tone. This tone is also available from a front panel jack. The second section of the 12AX7 is connected as an audio amplifier whose imput can be any source desired such as an external signal generator, F.M. tuner, tape recorder, microphone, etc. The minimum signal requirements for full modulation at this audio input is approximately 30 millivolts.

We will now turn our attention to the vertical deflection system. This deflection system consists of a neon lamp NE-2L and 6BE7 twin triode. The Television Analyst is synchronized directly to the 60 cycle power line and this is accomplished in the following manner. A high level signal taken from one side of the high voltage winding of the power transformer is fed into NE-2L. This lamp will not conduct until approximately 65 volts appears across it. Therefore, the sine wave introduced from the A.C. line from the power transformer is effectively clipped into a square wave whose peak to peak amplitude is approximately 130 volts. This signal is then used to key one half of the 6BE7, V-8A, into conduction. This allows capacitor C-204 to discharge through the tube and then during the scanning interval V-8A is cut off due to grid leak bias, and C-204 will again charge. When the keying pulse comes along to drive V-8A into conduction C-204 discharges during the retrace interval. The saw tooth signal thus acquired as capacity coupled into R-207 the vertical size control to the grid of the vertical output stage. The vertical output stages consists of the second half of V-8B. Vertical linearity it accomplished by adjusting the cathode resistance by means of R-206 the vertical linearity control. The transformer in the plates of V-8B matches the impedance between the vertical output tube and the deflection yoke. No vertical hold control is required since the vertical oscillator system is keyed directly from the A.C. line.

The horizontal deflection system consists of V-9 a 6CG7 connected as a cathode coupled multi-vibrator employing sine wave stabilization. The stabilizing network consists of L-201 the ringing coil tuned with a .005 mfd capacitor, making this network resonant to 15,750 cycles. Since L-201 is a relatively high "Q" device it exercises major control in establishing and maintaining the frequency of the oscillator. It is this coil which accounts for the excellent long term stability of the horizontal circuit. Two horizontal frequency adjustments are provided. One of them being R-11 the fine horizontal frequency which is a front panel control, and R-211 the coarse horizontal frequency control which is an auxillary adjustment located within the instrument. The saw tooth waveform developed as a result of the charge and discharge of C-216 is

14. CALIBRATE CONTROL. Calibrates the shorted turns tester and when rotated fully counter-clockwise to the "Leakage-Continuity" position calibrates the instrument for the leakage test on flybacks and yokes. If the Calibrate control is rotated clockwise the test indicator lamp will glow. To turn the lamp off, rotate the calibrate control to the Leakage Continuity position.

Output Jacks and Indicators

When not using a particular Drive Signal disconnect the Test Lead from the Jack, as interference will occur.

1. VIDEO OUTPUT. The signal at video frequencies is taken from the Video Output Jack. The polarity of the signal is controlled by the Video polarity (+ or –) switch. A separate lead is used for a ground return for this signal and for the following output signals. (Do not feed Video Signal to a point with voltage of more than 350 volts).
2. SYNC OUTPUT. High level composite sync signal is taken from this jack. Amplitude and phase are selected by the Sync Amplitude control.
3. COLOR. Color subcarrier (3.58 mc) output is taken from this jack for injection into chroma circuits.
4. 400 CYCLE. The 400 Cycle Tone signal from the audio oscillator is available from this jack at a fixed output level.
5. 4.5 MC. A 4.5 mc signal for sound system trouble shooting is available from this jack. Modulation is optional and is selected by the audio selector switch.
6. R.F. - I.F. OUTPUT. Output signal at the R.F. and I.F. frequencies are taken from this jack.
7. BIAS. The adjustable negative bias between 0 and 50 volts is available at this jack.
8. VERTICAL GRID DRIVE. Vertical Grid Driving Pulses are available from this jack to feed into the TV receiver being serviced. The amplitude of these pulses is controlled by the Vertical Drive Amplitude Control.
9. HORIZONTAL GRID DRIVE. Horizontal Grid Driving Pulses are available from this jack to feed into the TV receiver being serviced.
10. VERTICAL YOKE TEST SIGNAL. This jack provides a low impedance test signal to ground to directly drive the vertical winding of a deflection yoke.
11. A.G.C. KEYING PULSE. A high level positive going A.G.C. Pulse for use in keyed A.G.C. receiver circuits.
12. LEAKAGE-CONTINUITY. The Leakage Test for flyback transformers and deflection yokes is made between these two jacks. This test can be used to measure leakage of any component where sensitivities as high as 10 megohm is required.
13. FLYBACK YOKE TEST SIGNAL. Provides the necessary test signal to determine the presence of shorted turns in a flyback transformer or horizontal yoke winding.
14. TEST INDICATOR. This Indicator is used when making a shorted turns test on a flyback transformer or yoke. It is also used as the leakage indicator for the Leakage-Continuity Test.
15. PLATE DRIVE. The Plate Drive signal for either the vertical or horizontal system is available from this jack. The plate drive selector switch position determines whether it is horizontal or vertical drive.

16. B+ BOOST INDICATOR. This indicates the presence of B+ Boost in the receiver under test when plate drive from the Television Analyst is used.

17. HI VOLTAGE INDICATOR. Indicates the presence of Hi Voltage R.F. to the hi voltage rectifier plate.

18. PILOT LIGHT. Indicates that the Television Analyst is either "On" or in the "Stand-by" position.

Auxiliary Controls

In addition to the main controls on the front panel of the Television Analyst there are auxiliary controls located inside the instrument or on the rear of the chassis. The inside controls are accessible by raising the cover of the Analyst. The location of these controls are shown in Fig. 2. A duplicate of Figure 2 is located inside of the cover of the Analyst.

1. AUDIO GAIN CONTROL. (Rear of chassis). This Audio Gain Control is used to control the amount of input signal to the audio modulator when using an external audio source. This control has no effect when using the 400 cycle tone. The Off-Audio-Tone Switch must be in the audio position.

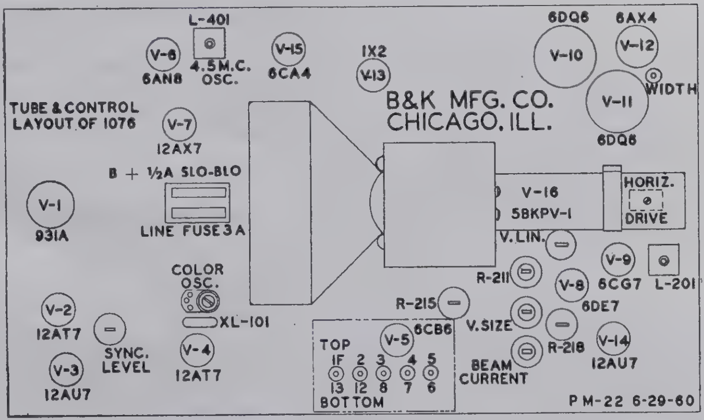

Figure 2
Layout of tubes and controls of the Analyst

2. AUDIO INPUT JACK. (Rear of chassis). External audio such as a signal from an F.M. tuner, Tape Recorder, Microphone etc. can be fed into this jack to modulate the F.M. oscillator.

3. SYNC LEVEL CONTROL. (R-121). This control sets the level of sync signal present in the composite video signal.

4. COLOR OSCILLATOR TRIMMER. (C-114). This capacitor trims the frequency of the color oscillator to the precise frequency required.

5. 4.5 MC OSCILLATOR ADJUST. (L401). This coil adjustment sets the frequency of the internal 4.5 mc F.M. oscillator.

6. WIDTH (L-2 located on the chassis between V-11 and V-12). This width coil controls the width of the horizontal scan on the 5BKPV1 scanning tube. Increasing the scan on 5BKPV-1 scanning tube reduces the size of the reproduced picture on the Television Receiver.

The electrical impulses which have been produced as a result of the light variation on the photomultiplier tube are developed across the photomultiplier load resistor R-102 on your schematic. This is a 1000 ohm resistor.

The video signal is capacity coupled to the grid of V-2A. V-2A is the first video amplifier. In order to improve the high frequency response of the system, inductive peaking is employed in the plate circuit of this tube and R.C. peaking is employed in the cathode circuit. In the plate circuit of V-2A there is a 500 ohm potentiometer which is part of the plate load resistor of V-3A. It is the common coupling between these two stages which mixes the synchronizing information with the video information to produce a composite signal of both sync and video. This signal is present at the plates of V-2A. This composite signal is capacity coupled to the grid of V-3B. Outputs are taken from both plate and cathode of V-3B and appear on the front panel as the video output, either sync positive or sync negative, depending upon whether the polarity reversal switch selects the plate or the cathode circuit. The plate load resistor for V-3B consists of two 470 ohm resistors. The signal present at the junction of the two resistors is capacity coupled to V-4A which is the R. F. modulator. The R.F. modulator receives in the cathode circuit the output of the raido frequency oscillator V-5. Also present at the cathode is the output from the 4.5 mc sound system and the output of the color oscillator. Modulation results in this tube, and the modulated R.F. output is taken from the plate and is capacity coupled to R-29A part of the R.F. Attenuator network. It is at this point that the modulated R.F. signal is available on the front panel.

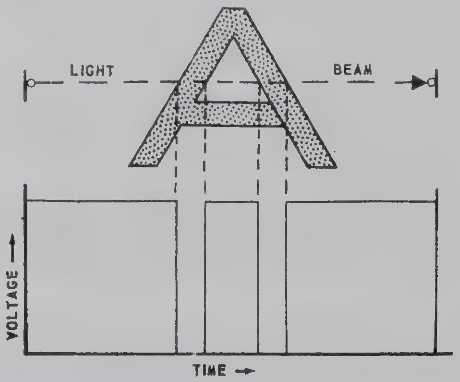

Figure 28—Voltage as Light Beam Moves Across Pattern

Synchronizing information is obtained by mixing a combination of vertical and horizontal signals in V-2B. A few turns of wire which form the secondary of the width coil L-2 provides the cathode return of V-2B. A vertical pulse from the vertical saw generator is applied to the grid of V-2B through suitable filtering to remove horizontal pulses. The mixing is accomplished in the plate circuit of this tube, and at pin 6, the plate, both vertical and horizontal sync information is present. This is capacity coupled to the grid of V-3A where additional amplification and clipping of the sync signal is accomplished. Part of the load resistor of V-3A is common to V-2A. This is the previously mentioned 500 ohm control which is the Sync Level Adjust. A potentiometer is connected from the plate and cathode of V-3A. When the potentiometer is in its center position it is affectively at signal ground an no output will appear at the sync output jack. As the potentiometer R-2 is rotated either clockwise or counter clockwise you will approach either the plate or the cathode signal. This enables the user to acquire either sync positive or sync negative at the venience, a block diagram of the complete instruments is shown in Fig. 26. Many of the circuits in this instrument are quite familiar to the service technician, because they are used in most television receivers. Some of these circuits are new and greater emphasis will be placed upon the description of these circuits.

The Scanning System

The first of these circuits pertains to the conversion of light energy to electrical energy. Certain materials have the ability to emit electrons when they are exposed to light, much the same as the cathode of a conventional electron tube does when it is heated. These materials are known as photoemissive materials. When a photoemissive material is used as the cathode of a diode, any light striking the tube will cause the cathode to emit electrons. These electrons, flowing through the diode load resistor, cause a voltage to be developed across the resistor. Such a tube is shown in front of a transparent slide in Figure 27.

As the small spot of light from the cathode-ray tube sweeps across the slide from left to right, light energy passes through the transparent portions of the slide. When the spot passes behind parts of the opaque "A" painted on the slide, the pattern blocks the light energy. Therefore, during some parts of the spot's sweep across the slide, light energy strikes the photoemissive cathode of the photo tube, while at other times it does not. This energy develops a varying voltage across the load resistor. Thus, part of the "A" on the slide has been changed to an electrical signal, as shown in Figure 27. As illustrated, when light energy is transmitted through the transparent portion of the slide, a voltage is developed across the resistor, and when the "A" blocks the light, no voltage is measured.

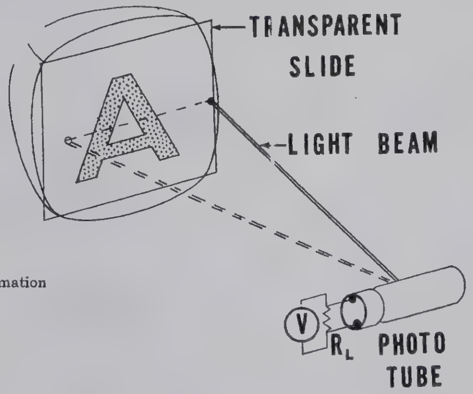

Figure 27—Changing Video Information to an Electric Signal

The cathode-ray, or "scanner" tube used in the Generator is specially designed to match the spectral response of the photomultiplier pickup tube.

As shown in Figure 27, the spot of light produced by the scanner starts at the top of the faceplate, sweeps across to one side, is blanked while it returns to the other side (retraces), sweeps to one side, is blanked while it returns to the other side (retraces), etc., until it finally reaches the bottom of the screen. It is then blanked and returned to the top of the screen. If the "A" of Figures 27 and 28 is placed over the face of the scanner tube, the dot of light and photomultiplier tube translates the entire pattern, spot by spot, into a video signal.

7. HORIZONTAL DRIVE. (C-219). This capacitor controls the horizontal drive to the horizontal output tube. Adjustment of this control establishes the operating conditions for the horizontal output tube and is effective in adjusting the horizontal linearity.
8. L-201 (Horizontal Oscillator Stabilizing coil). This coil assists in stabilizing the Horizontal oscillator frequency and is slug tuned.
9. V. SIZE. (R-207). This control adjusts the size of the scanning raster.
10. V. LINEARITY. (R-206). This control adjusts the vertical linearity of the scanning raster.
11. R-211. This is the coarse Horizontal Frequency Control and is adjusted to permit the front panel Horizontal Control to be centered in its range.
12. BEAM CURRENT. (R-221). This control adjusts the beam current of the 5BKPV1 scanning tube.
13. The centering magnets are located to the rear of the deflection yoke and control the centering of the scanning raster and therefore the centering of the reproduced picture.
14. The R. F. channel adjustments and the I.F. adjustments are slug tuned coils accessible through the holes in the shield of the R.F. assembly. The I.F. slug and channels 2, 3, 4 and 5 are the top slugs while the bottom slugs cover channels 6, 7, 8, 12 and 13.
15. R-218. This control adjusts the sensitivity of the Leakage-Continuity Test.
16. R-215. This control adjusts the voltage to the cathode of V-3A to calibrate the Sync Amplitude control on the front panel.

HOW TO SET UP THE TELEVISION ANALYST

The Television Analyst is an economical equivalent to a standard television field. Therefore, it follows that the operation and adjustments of this instrument are entirely different from the average test instrument found in the TV service field today. The adjustments which will be covered in these instructions in detail are quite simple. FAILURE to make these few adjustments may result in extremely poor performance of the equipment. IT IS, THEREFORE, MANDATORY THAT THESE ADJUSTMENTS BE MADE FOR PROPER OPERATION OF THE TELEVISION ANALYST.

The Television Analyst is an economical equivalent to a standard television station. Just as it is necessary for broadcast personnel to initially and periodically check and adjust their equipment, so too it is imperative that the same type of procedure be used with the Analyst. A decent respect for the tolerance of this equipment should be acquired by the owner so that he may understand its features, advantages and limitations.

The adjustments that are made at the factory are not necessarily the adjustments that will satisfy the conditions in your area. Not all broadcast stations throughout the country produce a test pattern that is identical in setup. It is necessary to make adjustments on the Television Analyst to set it for linearity, size and centering to match your local conditions. These adjustments are made in the following manner:

1. All areas have available at some time during the week a standard test pattern from a local TV station. We take advantage of this to setup to local conditions. Find out when this pattern is available, and allow the Analyst and a standard TV set to warm up for 5 to 10 minutes before using.

2. Tune in the station test pattern on the receiver. Find the mechanical center of receiver screen and adjust set so center of station pattern coincides with this point. Adjust receiver for good linearity, size and centering. Switch on and off the station several times to be sure the horizontal circuit of the receiver is not set at a critical point.

3. With a marking crayon or grease pencil draw circles on receiver front glass representing the circles of test patttern. The exact center of the test pattern is also marked on the face of the monitor.

4. Connect the Television Analyst R.F. output cable to the antenna terminals of the receiver along with an outside antenna.

5. Tune the TV receiver to a local channel and tune the Television Analyst to the same channel. Reduce the R.F. attenuator of the Television Analyst so that both pictures are superimposed on the receiver. It is sometimes more convenient to obtain this display with the Television Analyst on an adjacent channel.

The purpose of this adjustment is to compare the Analyst horizontal frequency to the station horizontal frequency. By adjusting the instrument Horizontal Control it is possible to have the Analyst signal slant to the left, to the right, or stand straight up, as it slides by. Adjust the Horizontal Control station picture. This puts the instrument exactly at station horizontal frequency. For reference, log the number on the panel to which the horizontal knob is pointing when instrument horizontal frequency is the same as the station frequency.

6. Tune the TV receiver to an unused channel in your area and the Television Analyst to the same channel. Adjust fine tuning on the receiver if necessary for best resolution. Adjust Television Analyst controls, Vertical Size and Linearity, Horizontal Size and Horizontal Drive, and centering so that the Television Analyst test pattern is superimposed over the circle drawn on the face of the monitor receiver. All linearity, size and centering adjustments are available by raising the hinged cover on the Television Analyst. Closing the cover will cause a very slight shift in the centering. Make your adjustments to compensate for this.

When these adjustments have been completed, you will then have matched your Television Analyst to the specific requirements of your area.

The long term stability of the Television Analyst is excellent. However, the factory recommends that all adjustments be checked periodically and that the face of the scanning tube be cleaned occasionally.

Where size, linearity and centering of a test pattern obtained from a local TV station is not the average of the most commonly viewed stations, it will be necessary for the technician to set his monitor receiver for a pattern size and centering that he knows from experience will provide viewer satisfaction when the set is in normal use.

This completes the adjustments necessary, and you may now use the Television Analyst for setup of TV receivers for linearity, size and centering, etc., with complete confidence that all receivers set up will meet YOUR local conditions.

All harmonics above Channel 6 will be absorbed by the filter, thus eliminating the high-band interference. Likewise, if the generator is set for a channel above Channel 6 and interference occurs at Channel 6 or below, use the filter and take the output from the high-band (Channels 7 through 13) terminals.

5. *Using the Television Analyst as a Video System Transmitter*

Operate the Television Analyst as directed under "Displaying Your Own Pictures." Write or type the names of the persons being paged on a transparent piece of acetate. To type on the acetate, shift the lever on your typewriter to position where ribbon is not used. Take 2 pieces of good quality carbon paper and insert acetate between them so carbon surfaces are against the front and back of acetate. Put in typewriter and type message in area 3-by4-inches. The clear slide provided has this area marked off. The acetate may be used again by just wiping the carbon printing off.

THEORY OF OPERATION

The Television Analyst is a complete flying spot scanner Video Signal Generator coupled with a radio frequency transmitter. For the reader's con-

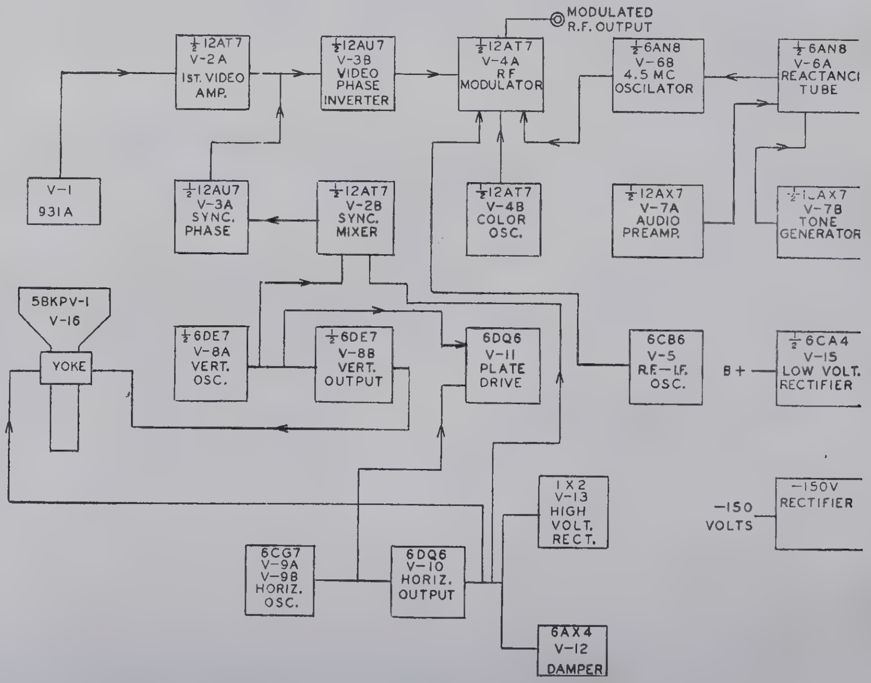
MODULATED R.F. OUTPUT
½ 12AT7 V-2A IST. VIDEO AMP.
½ 12AU7 V-3B VIDEO PHASE INVERTER
½ 12AT7 V-4A RF MODULATOR
½ 6AN8 V-6B 4.5 MC OSCILATOR
½ 6AN8 V-6A REACTANCE TUBE
V-1 931A
½ 12AU7 V-3A SYNC. PHASE
½ 12AT7 V-2B SYNC. MIXER
½ 12AT7 V-4B COLOR OSC.
½ 12AX7 V-7A AUDIO PREAMP.
½ 12AX7 V-7B TONE GENERATOR
5BKPV-1 V-16
YOKE
½ 6DE7 V-8A VERT. OSC.
½ 6DE7 V-8B VERT. OUTPUT
6DQ6 V-11 PLATE DRIVE
6CB6 V-5 R.F.—I.F. OSC.
B +
½ 6CA4 V-15 LOW VOLT. RECTIFIER
1X2 V-13 HIGH VOLT. RECT.
−150 VOLTS
−150V RECTIFIER
6CG7 V-9A V-9B HORIZ. OSC.
6DQ6 V-10 HORIZ. OUTPUT
6AX4 V-12 DAMPER

Figure 26—Block diagram of TV Analyst

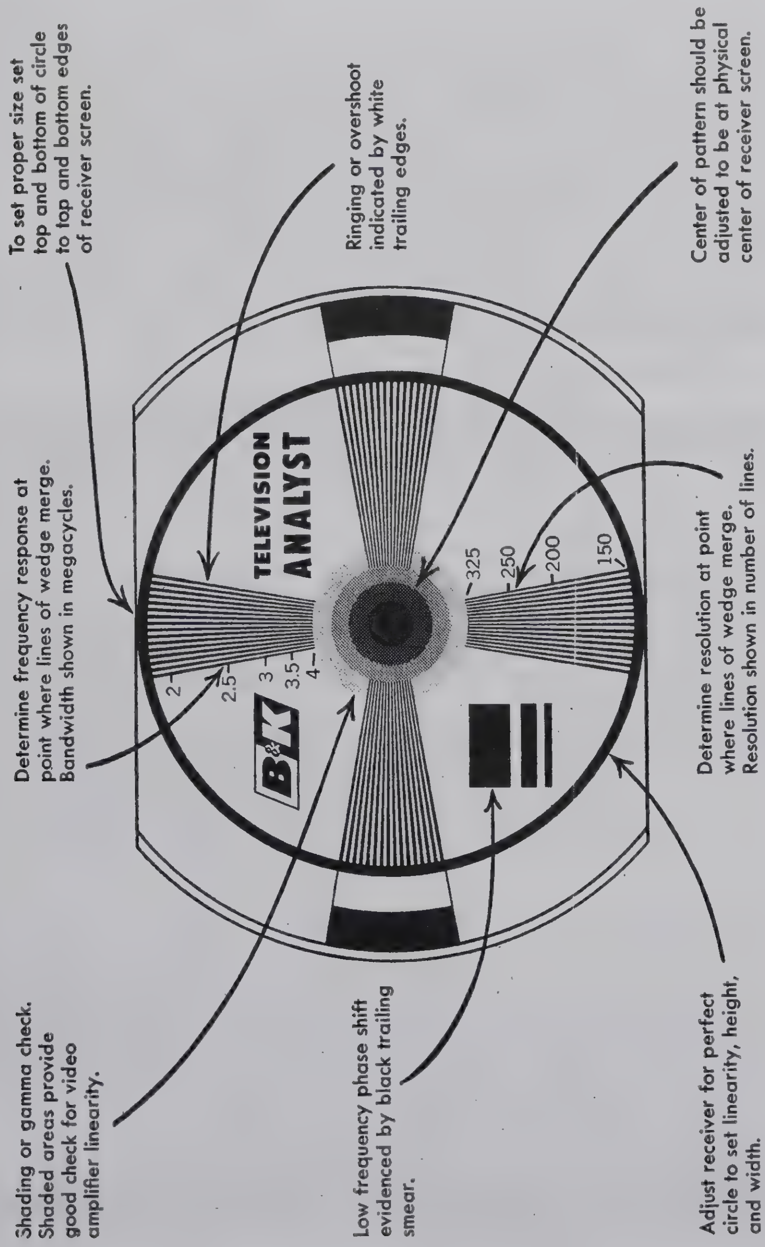
To set proper size set top and bottom of circle to top and bottom edges of receiver screen.
Ringing or overshoot indicated by white trailing edges.
Center of pattern should be adjusted to be at physical center of receiver screen.
Determine frequency response at point where lines of wedge merge. Bandwidth shown in megacycles.
TELEVISION ANALYST
B&K
2
2.5
3
3.5
4
325
250
200
150
Determine resolution at point where lines of wedge merge. Resolution shown in number of lines.
Shading or gamma check. Shaded areas provide good check for video amplifier linearity.
Low frequency phase shift evidenced by black trailing smear.
Adjust receiver for perfect circle to set linearity, height, and width.

Figure 25—Test Pattern

OPERATION OF THE TELEVISION ANALYST

In order to become familiar with the operation of the Television Analyst it is suggested that you set up, on a bench, an operating TV receiver. In this way you will become familiar with the procedure and with the available signals and their uses. Assume that you have an operating TV receiver before you and a B & K Television Analyst. The Television Analyst must first be set up as per instructions on page 7.

1. Plug the Television Analyst into a 117 volt, 60 cycle, single-phase A.C. power outlet. Turn power switch to "Stand-by" position.
2. Connect one end of the R.F. test cable to the R.F. OUTPUT JACK on the front panel. Connect the other end of this cable to the antenna terminals on the receiver.
3. Lift cover of analyst and insert test pattern slide into slide track. Push slide all the way. See figure 3. The glossy side of slides should always be towards the face of the scanning tube.

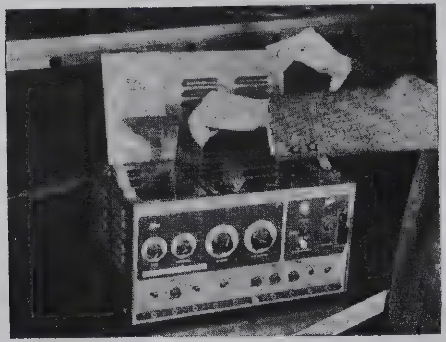

Figure 3—Inserting slide in TV Analyst

4. Turn the Television Analyst power switch to "ON".
5. Set the Channel Selector of the TV set at an unused channel, preferably Channel 6 or below. Set Analyst Channel Selector to the same channel.
6. Set the R.F. ATTENUATOR to number 5. Adjust fine tuning of monitor TV, if necessary.
7. Set brightness and contrast of monitor TV receiver at normal position. Advance VIDEO CONTROL for picture of good contrast. Adjust the VIDEO CONTROL so that the full range of grays near the center of the pattern is visible. If the VIDEO CONTROL is set too high, the picture will tend to overload and distort.
8. The HORIZONTAL CONTROL is adjusted in the following manner. Hook TV antenna and R.F. leads from Analyst to the antenna terminals of the monitor receiver. Tune monitor TV receiver to an On-the-Air TV station signal. Select the same channel on the Television Analyst, and a setting of the R.F. Attenuator, that will permit both pictures to be seen on the receiver. Adjacent channel

operation may be necessary to accomplish this. (For example Channel 3 & 4). Allow the monitor receiver to sync to the On-the-Air signal and observe the Analyst signal floating by horizontally. Adjust the HORIZONTAL control so that the Test Pattern picture stands straight up and barely floats by the TV station picture. This puts the instrument exactly at station horizontal frequency.

9. Set the AUDIO SWITCH to the "Tone" position. This will turn on the sound channel with a 400 cycle audio tone as the modulation. You will now be receiving a complete TV test pattern and an audio tone signal which is being generated by the Television Analyst and going completely through the monitor receiver.

In order to get the "feel" of the front panel controls, we will now adjust some of these controls to see the effect on the picture in the monitor.

Notice that adjusting the Video Control will change the contrast or black to white ratio of the received test pattern. The correct setting for this control is such that the picture shows the full range of greys. If this control is set too high, the picture will tend to overload and distort. Slides or photographs which have greater or less density than the test pattern slide will require a different setting of this Video Control for proper contrast.

Th R.F. Attenuator Control will allow maximum output signal when turned to the maximum clockwise position. As the R.F. Attenuator is turned down the output signal is gradually decreased until it falls to zero output. Zero output does not occur at the point marked zero on the R.F.-I.F. Attenuator but will occur at some point above it. Just before the output falls to zero an unstable condition is reached due to the extremely low level of the signal being transmitted. This unstable condition occurs at a level too low to be useful and can be ignored.

10. Turn the Audio Switch to external Audio position and inject audio signal from an external source into the External Audio Input Jack on the rear of the chassis. This signal volume can be controlled with the Audio Gain Control, also on the rear of the Television Analyst. Now, instead of a tone, the audio signal being received at the monitor TV receiver will be the audio signal being injected into the audio input jack of the Analyst. The built-in audio amplifier will accept signals from .01 to 5 volts, either low or high impedance. The volume control provides a means for adjusting levels to prevent over modulating the R.F. carrier. The 4.5 mc audio channel oscillator is accurately controlled even under varying line voltage conditions to stay within allowable frequency drift limits. The sound channel is frequency modulated with approximately 25 KC deviation at a frequency 4.5 mc above the video carrier.

After the user has become familiar with the operation of the main controls on the Television Analyst, he can proceed to learn to use the other signals available from the unit. (WHENEVER TESTING A TRANSFORMERLESS TV SET, USE AN ISOLATING 1 : 1 TRANSFORMER FOR SAFETY.)

11. Connect the R.F.-I.F. output cable to the grid of the first I.F. amplifier of the monitor TV receiver (making sure ground end goes to ground).
12. Select the I.F. position of the R.F.-I.F. Selector Switch.
13. Tune the I.F. Tuning Control to the correct I.F. frequency for the particular model receiver you are using as a monitor. The I.F. frequencies of the receivers being manufactured today and those produced within the last few years are mainly in the 45 mc region. There are, however, many sets in operation which still use the 25

OTHER USES FOR THE TELEVISION ANALYST

1. *Displaying Your Own Pictures and Patterns on Any TV Receiver*

The Television Analyst will transmit any positive and transparent picture or pattern. The only requirement is that the size of the pattern be limited to 3-by-4-inches. Hence, any pattern drawn with a black crayon on a piece of clear plastic or acetate the same size as the slides furnished with the instrument can be used in the slide-holder. One blank acetate slide is provided with the instrument. Be sure crayon side of slide is facing away from CRT tube. To display black-and-white photos on a TV receiver, merely have a positive film transparency made and use it in the slide-holder. For best results, the film transparency should be enlarged or reduced so that the picture area is about 3-by-4 inches. The full size of the film transparency should be 4⅞" x 6½" in order to fit properly.

2. *Adjusting Linearity and Size*

Connect Television Analyst to antenna terminal of receiver under test. Adjust generator to obtain test pattern of good contrast. Adjust vertical size and linearity of the TV receiver so that outer circle of the test pattern just fills the vertical height of the picture tube. Adjust horizontal size and linearity for as round a circle as possible. It may be necessary to re-adjust receiver vertical height and linearity after horizontal adjustments. The center of the test pattern should coincide with the center of the receiver picture tube. Adjustments of receiver centering controls will accomplish this.

3. *Checking Receiver Resolution*

Connect Television Analyst to the receiver under test. Set channel selector of TV Analyst to an unused channel. Set fine tuning of receiver to obtain a picture display of the best resolution. Adjust VIDEO control of Analyst for good contrast and shading. By observing the resolution wedges on the test pattern (See Fig. 25) one can determine the resolution of the receiver under test. The number of lines of resolution can be read from the test pattern by observing the point at which the lines in the wedges blend together. An average receiver should show approximately 250 lines of horizontal resolution, which is read from the vertical wedge in the test pattern. Any receiver that shows substantially less than 250 lines might be an indication that the receiver requires realignment. The Television Analyst signal when displayed at video through a good video monitor will reproduce a pattern of approximately 400 lines of resolution.

4. *Using the Television Analyst for Display Purposes*

To use the Analyst to display pictures on a number of TV sets, connect its output to the input of the master antenna amplifier through a suitable matching network. Adjust the CHANNEL SELECTOR control for a good picture on the display sets, on an unused channel. Set the R.F. ATTENUATOR so that overloading of the master antenna amplifier does not occur. Set the HORIZONTAL control for a stable picture. Set the VIDEO Control for best picture contrast. After these initial adjustments, only the VIDEO control will have to be adjusted for the different slides which may be used.

If the harmonics or fundamentals of the VHF oscillator interfere with a local station in the area, it may be necessary to use a high pass or low pass absorption filter to eliminate the interference. For example, if the Analyst is set to a channel below Channel 7 and interference occurs at Channel 7 or above, connect the output of the TV Analyst to the input of the filter and take the signal out of the low-band (channels 2 through 6) terminals of the filter.

1. Adjust the red vertical parabola amplitude and phase control to make the red vertical bar, along the vertical axis of the raster, parallel or coincident with the associated blue bar.
2. Adjust the blue vertical parabola amplitude and phase controls to make the horizontal blue bars, along the vertical axis of the raster, equally spaced or coincident with their associated horizontal red bars. (Since the horizontal convergence has not been completely set up, the associated red and blue horizontal bars will not necessarily appear parallel to each other).
3. Adjust the green vertical parabola amplitude and phase controls to make the vertical green bar parallel or coincident with the associated red bar along the vertical axis of the raster. (IF STEP B, (1) was set up properly, the red and green vertical bars will be parallel and the red and green horizontal bars along the vertical axis of the raster will be equally spaced. If these conditions do not exist, STEP B, (1) and (3) should be repeated).
4. Insert white dot slides in pattern generator and statically converge the three dots in the center of the raster.

STEP C—*Setup of the Horizontal Convergence Controls* (See Figure 24).

1. Insert white line slide in Television Analyst.

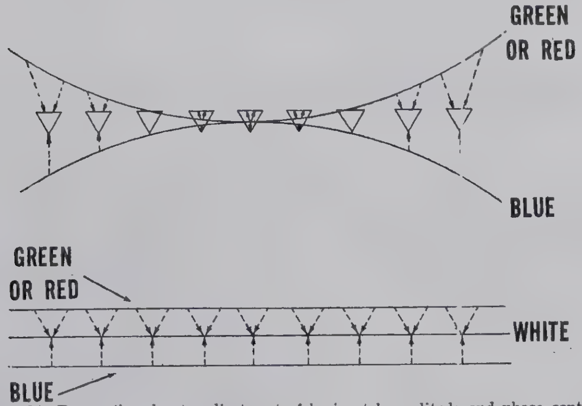

Figure 24—Dot motion due to adjustment of horizontal amplitude and phase controls

2. Adjust the red horizontal (parabola or sine-wave) amplitude and phase controls to make the vertical red bars across the horizontal axis of the raster equally spaced or coincident with the vertical blue bars.
3. Adjust the blue horizontal (parabola or sine-wave) amplitude and phase control to make the blue bar, along the horizontal axis of the raster, parallel or coincident with the associated red bar.
4. Adjust green horizontal (parabola or sine-wave) amplitude and phase controls to make the vertical green bars, along the horizontal axis of the raster, equally spaced or coincident with the associated red bars. (If STEP C, (2) was properly set up, the associated red and green vertical and horizontal bars will be parallel or coincident. If these conditions cannot be obtained, repeat STEP C, (2) and (4).

STEP D—Insert white dot slide and statically converge the dots in the center of the raster.

mc I.F. frequencies. You will notice that when you tune to the correct I.F. frequency you will again see the test pattern and hear the tone on the monitor receiver. Tune for best picture and sound.

14. Move the R.F.-I.F. output cable from the first I.F. to the grid and plate of the second I.F. and then to the grid and plate of the third I.F. tubes and notice how the reproduced video signal on the monitor screen becomes weaker and weaker. This is an effective way of determining whether an I.F. stage is contributing gain to the overall I.F. amplifier system. Notice that with only one I.F. stage, the last I.F. stage, being used there is still enough gain to reproduce the complete test pattern on the monitor receiver. In going through the I.F. stages, it must be noted that the R.F. Attenuator Control also controls the output level of the I.F. signals from the Television Analyst. Turn the audio selector switch to "Off" and remove the R.F. cable from the monitor receiver.

15. Using the test leads provided, connect the Ground Jack on the Analyst to the chassis ground or B— of the monitor receiver. Connect the Video output jack of the Analyst to the video detector load resistor of the receiver. This load can usually be found very easily by looking for the peaking coils associated with this video detector circuit. You will now see the complete test pattern once again, if the video signal is of the right polarity. If the picture is negative, reverse the polarity of the Video Polarity (+ or —) switch. If there is more than one video amplifier stage in the monitor receiver, the signal can be injected into the grid of the second video amplifier and the test pattern can again be reproduced. It will be necessary to reverse the polarity of the video polarity switch because the polarity of the signal is reversed in going through each amplifier stage. Remove the video output cable from the monitor receiver.

16. Connect the ground jack on the Television Analyst to the chassis ground, or B— of the monitor receiver. Connect a second test lead to the sync jack of the Television Analyst and inject this signal to the grid or cathode of the picture tube of the monitor receiver. Select the element which receives video modulation. Rotate the amplitude control to +50 volts and observe black and white bars running out of sync on the monitor receiver. Rotate the sync amplitude control to the —50 volt position, notice that the phase of the modulation on the monitor receiver changes. This signal is used to determine whether or not a picture tube will accept video modulation. Restore receiver to normal operation.

17. Turn the Audio Switch to "Tone" position and connect the appropriate test leads from the 4.5 mc Audio I.F. Output jack of the Analyst to the grid of the first audio I.F. (4.5 mc) amplifier. You will now hear the audio signal in the sound system of the TV receiver. Move this signal to the grid of the video amplifier and the tone will still be heard. To verify this signal, turn the Audio Switch to the "Off" position and see if the sound in the monitor speaker disappears.

18. Connect a ground lead of the Television Analyst to ground, or B— on the monitor receiver. Remove a sync amplifier tube from the monitor receiver. If this is a series string set, short out the heater pins in the socket of the tube just removed. This permits the remainder of the receiver to operate normally. Connect a second test lead to the Sync jack of the Analyst. Inject this signal to the plate of the socket of the tube just removed. Rotate the sync amplitude control to +50 volts. If this sync signal is of the proper phase, the picture on the monitor receiver will be properly in sync. If the

picture is not in sync, rotate sync amplitude control to the opposite phase, or —50 volts. This illustrates how the sync signal is used.

19. Plug the test lead into the 400 cycle Audio Tone jack and connect the other end of the cable to the grid of the first audio amplifier tube. With the Audio Switch in the "Tone" position, the 400 cycle signal will be heard in the TV monitor loudspeaker. (NOTE:—The Audio Gain Control of the Television Analyst does not control the gain of this tone signal). Move the test signal lead to the grid of the audio output tube. The tone again will be heard in the receiver speaker.

20. Remove the audio signal lead from the monitor receiver and connect the cable from the Vertical Grid Drive jack on the Analyst to the grid of the vertical output amplifier tube of the monitor receiver. Remove the vertical oscillator of the monitor receiver. If it cannot be removed because it is a dual purpose tube, or a series heater set, disable the oscillator circuit. Notice that the pulse from the Analyst will operate the vertical amplifier and produce a vertical sweep on the TV monitor receiver. The magnitude of the vertical sweep can be controlled by the Vertical Drive Amplitude control. This sweep may not be linear, or it may not fill the complete vertical size of the picture tube because the pulse may not be matched to this particular vertical output circuit. However, it can very nicely and qualitatively determine whether the vertical amplifier circuit is operating correctly.

21. Remove the vertical pulse lead from the monitor and the Television Analyst. Connect the lead from the Horizontal Grid Drive Pulse output jack on the Analyst to the grid of the horizontal output tube (6BG6-6BQ6). Disable the TV set horizontal oscillator, or remove it from its socket. Note: Do not turn the TV set on without any horizontal driving pulse to the horizontal output tube (either from the Analyst or the horizontal oscillator of set. Without driving pulses to the horizontal output tube, the tube will burn up).

    You will notice that the horizontal output of the monitor receiver has a complete horizontal sweep and provides high voltage through the high voltage rectifier, of the receiver. This will provide a quick check to determine whether the fault is with the oscillator circuit or the output circuit in trouble shooting horizontal circuits.

22. Remove the Horizontal Grid Driving lead. Connect a test lead from the Plate Drive Jack on the Television Analyst to the plate cap connector of the flyback transformer (the horizontal output tube plate cap) of the test receiver. We are actually replacing the horizontal section, including the output tube of the receiver with the horizontal section and output tube in the Analyst. Put the Plate Drive Selector switch on the Television Analyst to the Horizontal position. Turn on the test receiver. The test receiver will now have full Horizontal scan and high voltage. The Television Analyst is providing complete drive for the horizontal output transformer of the test receiver. The B+ Boost indicator on the Television Analyst will also light indicating that B+ Boost is present in the test receiver.

23. Remove the horizontal plate drive lead from the plate cap of the flyback, and restore set to original condition. Now connect plate drive lead to the plate pin of the vertical output tube of the test receiver. Remove the vertical output tube of the test receiver. Put the Plate Drive Selector switch of the Television Analyst to the Vertical position. Apply power to the test receiver. Vertical scan will now result. The size of the scan on the test receiver can be adjusted by means of the Vertical Drive Amplitude control on the front of

Since static convergence is primarily concerned with the center dot, the serviceman must make his adjustments to this dot. Figure 22 in the instruction manual show the motion of the red, green and blue dots which the static convergence magnets will produce. Careful adjustment of the static convergence magnets will cause the three dots to superimpose and become white. If when the three dots (red, green and blue) are separated with the static convergence magnets they appear of unequal size, reduce the background or screen control associated with the larger dot, or dots, until the size of all three dots are approximately equal. When static convergence is then accomplished the center dot will be white. Color fringing may appear on the other dots on the face of the color television set and this then indicates that dynamic convergence adjustments are required.

Since each step of convergence requires that the entire procedure be properly completed, the purity of the receiver must be correct as explained above.

Dynamic Convergence Adjustments

After purity and static convergence adjustments are made, you are then ready to make dynamic convergence adjustments. Insert the white-line slide in the generator. Be sure to set horizontal to correct frequency as explained previously. It is of utmost importance in color convergence that the horizontal frequency is adjusted accurately.

If horizontal frequency tends to drift a few cycles, as noted by a slight vertical movement of the horizontal lines, it can be stabilized by a slight adjustment of the HORIZONTAL control.

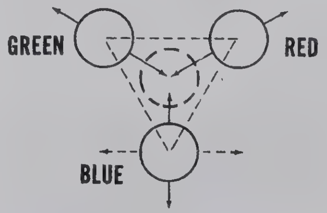

Figure 22—Direction of dot movement for static convergence

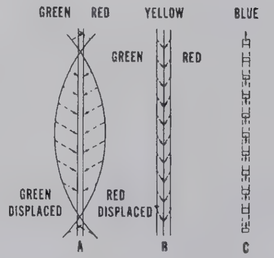

Figure 23—Dot motion due to adjustment of vertical phase and amplitude controls

STEP A—*Preliminary Adjustment*

1. Turn the blue horizontal (parabola or sine-wave) amplitude control to maximum.
2. Adjust the blue horizontal (parabola or sine-wave) phase so that the dip in the horizontal blue bar appears in the center of the horizontal axis of the raster.
3. Re-adjust the blue horizontal (parabola or sine-wave) amplitude to produce a reasonable straight horizontal bar along the horizontal axis of the raster.

STEP B—*Setup of the Vertical Convergence Controls (See Figure 23).*

The color demodulators are now properly aligned so that no +(R-Y) signal gets through the +(B-Y) demodulator, and also no (B-Y), signal gets through the +(R-Y) demodulator. Also the front panel hue control is in the middle of its range to allow variations in both directions if necessary.

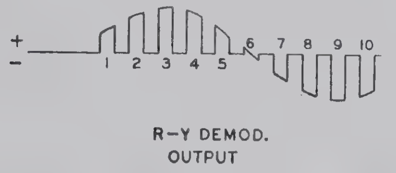

Figure 20—(R-Y) demodulator output as seen on an oscilloscope

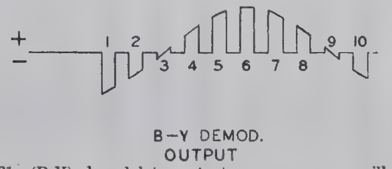

Figure 21—(B-Y) demodulator output as seen on an oscilloscope

This completes the hue control and demodulator adjustments.

HOW TO ADJUST COLOR PURITY AND CONVERGENCE

Adjusting Color TV Purity and Static Convergence

The first adjustment normally made on a color set is purity. It is best to follow the set manufacturers' procedure for purity adjustment. It is, however, most desirable to make this purity adjustment on a blank synchronized raster. This can be accomplished by connecting the generator to the color receiver antenna terminal and tuning in a test pattern, as previously explained. Then remove slide from pattern generator and make purity adjustment on synchronized blank raster.

For static convergence adjustments it is necessary to use the white dot slide supplied with your Television Analyst. The size of the dot supplied by the Analyst has been selected for the most accurate convergence adjustment.

Since static convergence is performed using only the center dot, this dot is surrounded on the Analyst pattern with a series of square dots. This makes it convenient to identify the center dot.

The following procedure is recommended for setting the Analyst to produce a clear, clean dot for use in color convergence.

1. Use the test pattern slide of the Analyst and obtain a good black and white pattern on the color receiver. Keep the RF Attenuator setting as low as possible when making this adjustment.
2. Remove the test pattern slide and insert the dot slide. Readjust the brightness and contrast controls on the receiver to get the proper dot display. Use as low a brightness level as possible on the television receiver to keep the dot from blooming and becoming enlarged. It may be necessary to slightly increase the video output of the Analyst. Excessive video level on the Analyst will also cause the spot to bloom. Improper adjustment of the brightness and contrast control of the receiver or improper adjustment of the video control on the Analyst may result in an unstable dot pattern and blurred dots. It must be emphasized again that the brightness level of the television set must be as low as possible to prevent defocusing of the dot.

the Television Analyst. The scan will not necessarily be linear but provides an excellent test on the vertical output transformer and yoke. Disconnect the Plate Drive test lead and reinsert the vertical output tube in the test receiver. Turn the Plate Drive Selector switch to the "OFF" position.

24. Disconnect the leads of the vertical winding of the deflection yoke of the test receiver. Connect one lead to ground on the Analyst and the other lead to the Vertical Yoke Test Signal jack on the Television Analyst. Turn on the test receiver. Vertical Scan will be seen on the test receiver. While not linear in deflection it proves that the vertical yoke will provide deflection. Remove test leads and reconnect vertical yoke leads to the test receiver.
25. To test a transformer for shorted turns connect the shielded cable to the Flyback-Yoke test signal jack. Adjust the Calibrate control until the test indicator lamp just goes out. Connect the flyback transformer to this cable. The connection is made from horizontal output plate cap connector to hi voltage rectifier plate cap connector. If the test indicator glows this indicates that the transformer has shorted turns. This test will respond to as little as one shorted turn. If the component to be tested is the horizontal winding of the deflection yoke, connection is made across the deflection yoke winding. It is also important to test the yoke for leakage between the vertical and horizontal winding and from the horizontal to the metal frame of the yoke. Do not use the yoke test on the vertical winding, as erroneous results will be obtained.
26. To observe the action of the Negative Bias Supply, connect the Television Analyst to obtain a picture on the test receiver. Connect a ground lead from the Television Analyst to the test receiver and connect a test lead from the Negative Bias supply output jack to the A.G.C. buss of the test receiver video I.F. stages. Set the R.F. Attenuator of the Analyst to number 10, maximum R.F. output. Since the bias supply is very low impedance it will take over control from the high impedance A.G.C. system. In other words, the A.G.C. bias being fed back from the A.G.C. network is completely overcome by the bias voltage we are feeding in from our supply. We can now control the A.G.C. bias and therefore the test receiver gain. Adjusting the bias supply varies the receiver gain. With the bias supply set to —50 volts the receiver will be cut off and no picture will be seen. As the negative bias supply voltage is reduced a picture will become visible. Most receivers will begin to show a picture in the region —6 to —12 volts. As the bias voltage is reduced even further the picture will begin to overload. This will usually show up as snaking in the picture due to sync clipping. If the bias is reduced even further the picture will get blacker and then will reverse phase and then completely disappear at zero bias, indicating complete blocking of the receiver. Disconnect the bias test leads and restore the test receiver to normal operation.
27. Connect the R.F. output of the Analyst to the R.F. antenna terminals of a color TV receiver. Tune the receiver to an unused TV channel tune the Analyst to that same channel as described above. With the black and white test pattern showing, on the Color TV screen, turn the Color Switch to "On". This will switch on the 3.58 mc color rainbow generator signal. This signal will produce a color spectrum. The color sequence of the spectrum is as follows: Reddish Orange at the extreme left side of the tube, followed by a gradual transition to Red, Magenta, Blue, Cyan and Green at the right side of the tube. This color rainbow signal can be used to isolate defective stages in the color section of the color TV receiver. This chroma signal can also be fed into the I.F. section. By taking the color signal from the 3.5 mc color jack it can be fed directly into the video and chroma sections.

TROUBLE SHOOTING WITH THE TELEVISION ANALYST

The Television Analyst provides the service technician with a powerful tool to quickly and accurately trouble shoot television receivers. Outputs are provided, to enable the service technician to inject signals into any section of a TV receiver to isolate trouble to (1), a section of a receiver, and (2), to the specific stage. In many cases it is also possible to locate the exact defective component. This method of trouble shooting is called signal injection. The Television Analyst provides output signals which can be injected into any of the stages shown in Fig 4. The indication as to whether or not that portion of the receiver is capable of processing the television signal properly is seen directly on the screen of the television receiver being serviced. Signal injection is best accomplished by starting at that portion of the receiver that is farthest from the antenna.

For example:—a defective receiver is to be serviced where the complaint is "no video". Refer to Fig 4. The farthest point from the antenna in this case would be point J, the grid of the picture tube. The high level signal from the Sync output jack would be injected at this point. If the picture tube is capable of showing video, black and white blanking bars running out of sync will be seen. If the Phase of the sync signal is reversed with the Sync Amplitude control the phase of the Black and White bars will be reversed. The signal must of necessity be out of sync since the sync take off point in most receivers occurs in the video amplifier section of the receiver.

Since the picture tube circuits checked out we must now inject a video signal at point H, the grid of the 2nd video amplifier. This video signal is obtained at the Video Output jack on the Television Analyst. If the 2nd video amplifier is working properly the test pattern will be displayed on the picture tube. The signal should also be in sync since the sync take off point occurs in the second video amplifier. The proper phase of video must be selected by means of the Video Polarity switch located directly above the Video output jack. We now move our video test signal to point F, the grid of the first video amplifier, as shown in Fig. 4. Remember to reverse the phase of the video signal to account for the 180 degree phase reversal that occurs in the first video amplifier. If the test pattern failed to appear on the picture tube with the signal injected at point F we would know that our trouble must lie between point H and point F. Obviously the first video amplifier is defective. A few voltage and resistance readings will quickly locate the defective component.

If however, with the test signal injected at point F we saw a test pattern on the picture tube of the receiver, we would then have to inject a signal at points E, D and C (the grids of the I.F. amplifiers) at the I.F. frequency of the receiver. This is done by setting the R.F.-I.F. Selector switch to the I.F. position and setting the I.F. tuning to the correct frequency. Using the shielded cable provided and connected to the R.F.-I.F. output jack, inject signals to the grids of the third, second and first I.F. amplifier stages. If the test pattern signal should fail to appear on the screen of the picture tube at any of these points then the defective stage has been located. This same technique can be applied to the Tuner, the Sound system, the Sync circuits and the Deflection circuits.

As long as the signal injection point is somewhere along the series path that the signal must travel from the antenna terminals all the way through to the picture tube or loud speaker, this complete signal path can be analyzed in minutes. Included in this series path are all of the series components which are directly involved in passing the signal; for example, inter-stage I.F. transformers, video peaking coils, coupling condensers, etc.

The Television Analyst can also be used to trouble shoot intermittents. The following portions of this manual cover the methods used to trouble shoot other parts of a TV receiver, giving step by step procedures.

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since it is 180° from reference signal. Fig. 19 will be extremely useful in servicing color TV receivers since it will enable you to evaluate performance of the receiver. It will also enable you to check the range of the hue control and will provide a simple method of color demodulator alignment.

Since most of the color TV receivers in use today demodulate an +(R-Y) and a +(B-Y) signal, our discussion of demodulator alignment will refer to this condition only.

Connect the Television Analyst to the receiver under test and set up and adjust for a proper picture on the TV receiver. Be sure that the horizontal frequency of the Analyst is adjusted to the correct frequency. This is explained in your instruction manual. Turn the color signal on and insert the color bar slide into the Analyst. Adjust video control on the Analyst to get good reproduction of the bars and adjust chroma and hue controls for the proper level of the color signal and that the color bars occur in the proper sequence as shown in Fig. 19. If the color bars do not fall into the proper sequence, the coarse adjustment of the hue range found inside the receiver will center the range of the hue control. At this point it is well to indicate that the horizontal width of the receiver under test should be reduced to be certain that all ten bars are seen.

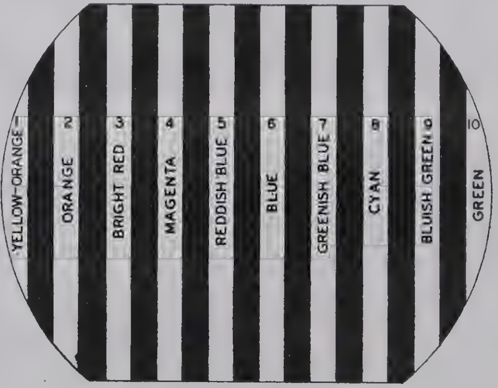


Figure 19—Color bar pattern showing each bar, its number and its color

From fundamental color theory we know that the output of the +(R-Y) demodulator if properly adjusted should have zero +(B-Y) output, and the output of the +(B-Y) demodulator should have zero output of +(R-Y) signal.

Since our color bar pattern has both an +(R-Y) signal which is the third bar, and a +(B-Y) signal which is the sixth bar, we can use these signals to check and align color demodulators.

Connect an oscilloscope of adequate band width to the output of the +(R-Y) demodulator. You will see a waveform similar to that shown in Fig. 20. This is viewed at a 15,750 cycle per second sweep on the oscilloscope. The sixth bar which is +(B-Y) should be at zero amplitude as shown in Fig. 20. If this condition is not met, set the hue control to its center position and adjust the coarse hue control adjusment which is located within the TV receiver so that the sixth bar is at zero amplitude. Now move the oscilloscope to the output of the +(B-Y) demodulator and adjust the quadrature transformer driving the +(B-Y) demodulator so that the third bar which is +(R-Y) is at zero amplitude as shown in Fig. 21.

from yellow to orange, red, blue and ending in green. This method of producing the color signals is called off-set sub-carrier operation.

By referring to Fig. 18 you will see the vector display of the color information that can be obtained for a phase shift of any given number of degrees. For example, 60° represents a +(I) signal. A 90° phase shift represents +(R-Y). 180° represents +(B-Y) and a +300° represents (G-Y). In order to change a color rainbow signal to a color bar signal, we merely have to blank out those portions of the rainbow display that we do not want and allow the portion of the rainbow that we do want to come through. This we accomplish with the color bar slide enclosed in your accessory package. You will note that there are ten light intervals and nine dark intervals equally spaced on the slide. Each bright interval, or bar, represents a color phase shift of 30° and is so placed on the slide as to give the colors as indicated in Fig. 19. You will note for example in Fig. 19 that the second bar is indicated as orange and its color corresponds to +(I) since it is 60° from the reference signal. The sixth bar for example, is a blue color and corresponds to +(B-Y)

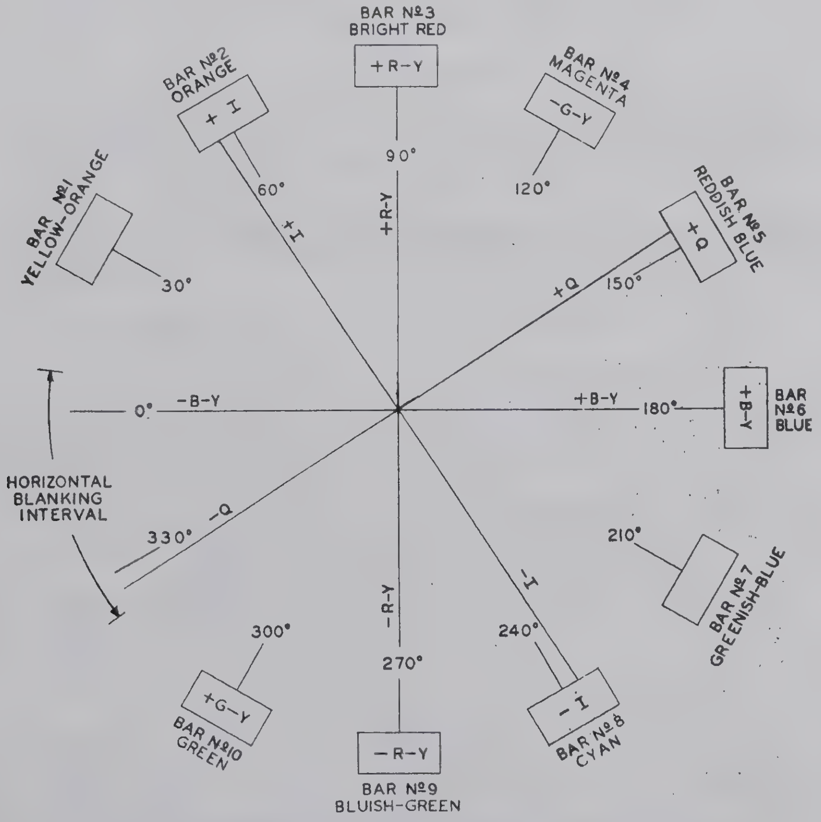


Figure 18—Vector display showing color bars and angular displacement for each bar

HOW TO USE THE TELEVISION ANALYST FOR TROUBLE SHOOTING INTERMITTENTS

TV receivers which come into the shop for intermittent troubles can be extremely time consuming and cause a great deal of irritation to the service man. This is especially true when the technician cannot even isolate the section of the receiver where the source of the trouble is located.

As a typical example, let us assume a TV set has a video coupling condensor (C4) which is opening up at random intervals for just a few seconds at a time.

The block diagram Figure 4 shows all the sections of the receiver. By using the Television Analyst we can inject signals at various points in the receiver and by observing the results isolate the difficulty down to a section or single stage. Once the stage has been isolated it is just a matter of checking the individual components in that stage to determine the actual culprit.

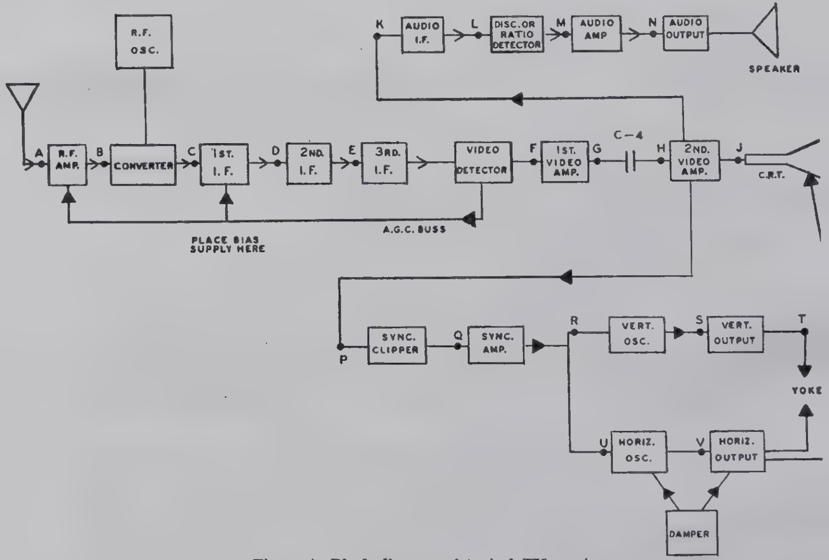


Figure 4—Block diagram of typical TV receiver

Many service men after narrowing an intermittent trouble down to one stage find it economically sound to replace the suspected components one by one until the guilty one is found. When you consider the cost of your time, it is often wise to "waste" a few 20c capacitors to save ½ hour of your time.

In the typical example:—The customer complained that the picture and sound went off for a few seconds every ten minutes. The service man in the field ascertained that when this occurred the raster was still there, eliminating the possibility of A.C. power failure, or D.C. power supply trouble. In order to get a raster, the low voltage supply must be working as well as the complete horizontal and vertical sweep and high voltage circuits.

By looking at the block diagram it can be seen that the video and audio signals are together in all the R.F., I.F. and Video stages. It is after the last video amplifier that the video and audio separate. Since both video and audio are lost when the intermittent trouble appears, it is obvious that the trouble must be in the R.F. tuner, I.F. amplifier, Video detector, Video amplifier or A.G.C. circuits.

The Television Analyst will now be used to locate the source of the trouble. The signals available from the instrument will be injected into the receiver at various points, so that by the process of elimination the trouble can be analyzed down to one stage.

First it is necessary to disable the A.G.C. circuits by connecting a bias supply to the A.G.C. buss which feeds A.G.C. voltage to the tuner and I.F. amplifier stages. (Incidentally, if the trouble were in the A.G.C. circuit, using this external bias supply would probably eliminate any symptoms of trouble. This would indicate that the source of trouble was in the A.G.C. Circuits).

Now by feeding R.F. signal into the antenna terminals of the set (A) the test pattern and sound will intermittently disappear, just as it did on the local TV stations.

By moving our signal injection point stage by stage from the antenna terminals to the picture tube, we can localize the trouble. Still using R.F. ouput, inject the signal on the grid of the R.F. converter tube (B). If the intermittent still appears, it means that the trouble is NOT in the R.F. amplifier stage, or the R.F. oscillator.

Now we switch the instrument output to the I.F. signal, and inject this signal at the same point at the grid of the converter (B). (Note:—If the intermittent appeared when R.F. signal was fed to the grid of the converter, and it did *not* appear when I.F. signal was fed into the grid of the converter, then the trouble would have been pin-pointed directly to the R.F. oscillator).

With I.F. signal fed into the converter grid (B) we find that the intermittent still appears. That means the R.F. oscillator is not causing the trouble.

Now we move our signal cable to the grid of the first I.F. amplifier (C). Finding the trouble still intermittently appearing, we move our signal to the second (D) and the third (E) I.F. stage. (Obviously, if the trouble appeared when injecting on the grid of the second I.F. stage (D), but no longer showed up when injecting signal to the third I.F. stage (E), the trouble would have been pin-pointed to the second I.F. stage).

Since the intermittent still appeared, the Television Analyst signal output is now switched to Video and the signal is injected into the video detector load. (See Figure 5). This is usually around a 4,000 ohm resistor and can easily be located because it will have a video peaking coil associated with it. (Note:—For video signal make sure you are using the correct output cable as it is *not* taken from the same output jack as the R.F.-I.F. signals. Also, if the picture appears negative, reverse the polarity of the video signal with the Video Polarity (+ or —) Switch).

Since the intermittent trouble still appears, the video detector has been eliminated from suspicion and the video signal is injected on the grid of the first video amplifier (F). The intermittent trouble still shows up at this point.

The video signal is now injected into the grid of the second video amplifier tube (H) after reversing the polarity with Video Polarity (+ or —) Switch to compensate for the 180° phase reversal in the first amplifier tube. Now, for the first time, the intermittent disappearance of sound and video is no longer evident. The trouble has been isolated to an area between the grid of the first video amplifier (F) and the grid of the second video amplifier (H).

Now to use the Television Analyst once more to check the coupling capacitor (C-4) from the plate of the first video amplifier to the grid of the second video amplifier. Inject the video signal on the plate side (G) of the coupling

could be developed by the circuit and it would prevent the development of the normal amount of high voltage or the normal amount of horizontal drive for the yoke. If C-2 should open, the circuit would again be disrupted by the lack of boost B+ voltage. B+ voltage, however, would still appear because the damper tube and L-1 would still be intact.

The foregoing examples indicate the complete flexibility of this instrument. With continuous use the technician will certainly develop his own procedure which will completely remove all of the complexities of Sweep Circuit Analyzing.

TROUBLE SHOOTING CHROMA CIRCUITS

Loss of color, weak color or distorted color can occur in the R.F. or I.F. sections of a receiver as well as in the Chroma Circuits. The Analyst is particularly useful in trouble shooting this type of complaint as either the R.F. or I.F. signal may be modulated with the Rainbow Color signal and this signal injected, into the R.F. or I.F. stage by stage to localize the defective stage.

The Chroma signal is also available at the output jack labeled Color and may be injected directly into the Video Detector, Video Amplifier, Band pass Amplifier or to the grid of low level demodulators.

These tests quickly pin down complaints of no color, weak color, and distorted color. They also localize phase errors by showing the wrong sequence of colors.

Phase errors arise in the Chroma section, or in the I.F. section. It is possible for the R.F. section or Video section to cause phase errors, but these are less common trouble points. If you inject the Chroma signal into the Band pass Amplifier and get a normal color pattern the next step is to inject an I.F. signal modulated with chroma information at the input of the I.F. Amplifier.

When a phase error is found in the latter test, it is indicated that the I.F. Amplifier is in need of proper alignment. On the other hand, a phase error in the former test indicates the need of Chroma circuit alignment.

A color bar pattern slide is enclosed in the accessory package of your Television Analyst to enable you to convert the rainbow pattern which it produces into a color bar pattern of known colors. Too high a setting of the Receiver Chroma Control will result in having only the three primary colors displayed. At this point it might be well to review the principle of operation of a rainbow pattern and then relate it to a color bar pattern.

The different hues that can be produced in a color TV receiver are obtained by shifting the phase of the color sub-carrier of the transmitted signal with respect to the reference burst which occurs during the horizontal blanking interval. For example, if the phase of the sub-carrier is shifted slowly through a complete 360° with reference to the burst signal, the hue will change from yellow to orange, to red then magenta, blue cyan and green, and all of the intermediate hues between those colors. If the phase of the sub-carrier signal is continuously changed thru a full 360° during the interval of one horizontal line and repeats itself for each following horizontal line, a continuous rainbow of colors will be produced. Instead of shifting the phase of the sub-carrier in the TV Analyst, we will make the frequency of the sub-carrier lower than the color oscillator in the TV receiver by 15,750 cycles. There will then be a one cycle per line difference between the sub-carrier and the oscillator in the receiver. Since over a period of one horizontal line there is one cycle difference between the two signals, we have effectively created a 360° phase shift per horizontal line which will repeat itself each horizontal line. This will result in a rainbow display showing each of the colors in the color spectrum until the test indicator lamp just goes out. Connect the flyback transformer to this cable. The connection is made from horizontal output plate cap connector to hi voltage rectifier plate cap connector. If the test indicator glows this indicates that the transformer has shorted turns. This test will respond to as little as one shorted turn. If the component to be tested is the horizontal winding of the deflection yoke, connection is made across the deflection yoke winding. It is also important to test the yoke for leakage between the vertical and horizontal winding and from the horizontal winding to the metal frame of the yoke.

Another very common arrangement is the autotransformer shown in Fig. 17. Here there is one winding to which all taps are made. The horizontal output tube is connected at point A and the stepped-up voltage for the high voltage rectifier tube is obtained from point B. Horizontal deflection yoke coils are connected across points C, D and E. All of the testing methods just outlined for the isolation horizontal output transformer are applicable here, too. The boost indicator and hi voltage still function as before, for the same conditions, and both are connected as before. The ability of the instrument to check for continuity can be put to good use here because continuity should exist between all points on the transformer. If continuity is not obtained, the transformer is open.

In Fig. 17 L-1 serves primarily as a filter coil. If this component should open, no B+ would be available to the horizontal output tube, and if L-1 was shorted, the circuit would still operate normally; it is quite possible that considerable RF interference would appear in the picture. If no interference did appear, there would be no visual indication of a short in L-1. If C-1 should short, the damping tube would be effectively cut out of the circuit and no boost B+ would be developed. B+ voltages, however, would appear on the B+ boost line and at the plate of the horizontal output tube. If C-1 should open, it would have very little effect on overall operation, although here, again, RF interference might appear in the image.

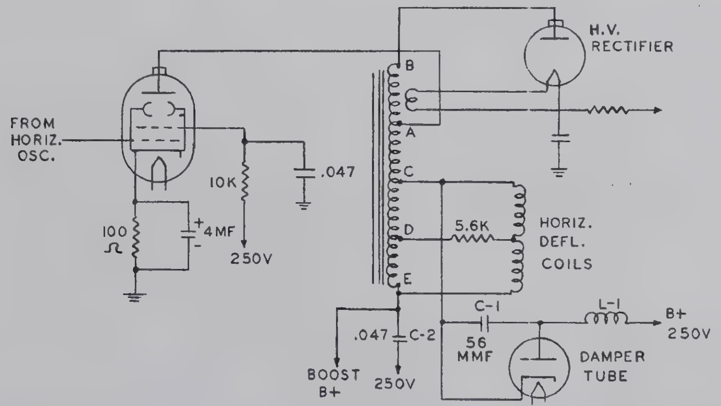


Figure 17—A Horizontal Output Section using an Auto Transformer type of output transformer

Capacitor C-2 is the component receiving the additional voltage which the damper tube develops. If C-2 should short, no boost B+

capacitor (See Figure 5). The intermittent condition again appears, placing the blame for intermittent loss of signal to the coupling capacitor C-4 which is opening up intermittently.

(If it were the first video amplifier tube itself, screen bypass capacitor C-1, plate load resistor R-2, peaking coil L-4, or any other component in the first video amplifier circuit, the trouble would not have appeared with the signal injected at point (H) in the circuit. However, if the signal was injected at point (K) on the plate of the first video amplifier and the same intermittent indication appeared, then both the peaking coil L-3 and the coupling capacitor C-4 would be suspected).

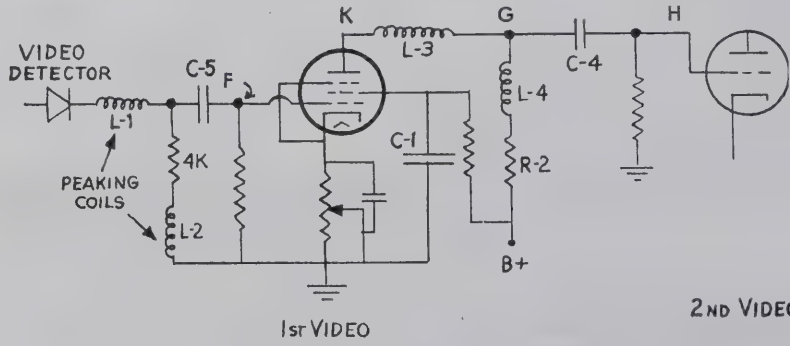


Figure 5—Video section of typical TV receiver

It should be clear at this point that the signal injection procedure can actually begin at either end of the circuit. That is, we could have started at video and worked toward the R.F. Tuner, or start at the Tuner and work toward the Video. Each individual technician will develop his own technique for use of the instrument. Where the trouble is an intermittent one, then it is sometimes preferable to start at the tuner because we are looking for a "drop out or loss" of signal for short intervals.

Where the trouble is in the circuit constantly, it may be preferable to start at the video end and work toward the R.F. tuner. Also it is evident that as the technician becomes more familiar with the instrument he will skip stages for quick analysis and take complete sections at one time (I.F., R.F., Video). After determining which section is at fault, he could then signal inject to find the one stage or component which was at fault.

Let us take another example of a receiver which comes into the shop having intermittent sync. The sync circuit of this receiver is shown in Fig. 6. Let us trouble shoot by signal injection from the rear of the signal path. We inject sync signal from our Television Analyst to the plate of the 6BF6 sync amplifier. We would now observe the raster of the television set and would see that it was in sync.

If the picture now remains in sync, this would tell us that from the plate of the sync amplifier tube into the oscillators there was no trouble. We would now shift our point of sync injection to the grid of the 6BF6 sync amplifier. At this point we would have to reverse the phase of the sync signal to allow for the phase inversion of the sync amplifier tube and also reduce the level of the sync signal to take into account the gain of this stage. Again we would observe the picture on the face of the tube and watch for the intermittent trouble to occur. If it did not occur, we would know that there was no difficulty from the grid of this amplifier tube all the way through to the oscillators.

We will now shift our sync signal to the plate of the 6AU6 sync separator and again observe the picture on the face of the CRT. We now find that the intermittent sync condition occurs. This tells us that the trouble lies between the plate circuit of the 6AU6 sync separator and the grid circuit of the 6BF6 sync amplifier. A few voltage and resistance measurements would now certainly point out the trouble. It might even be worth while to replace all of the components that lie between plate of the 6AU6 and the grid of the 6BF6, since this would save a great deal of time and would eliminate the necessity of determining which component is intermittent.

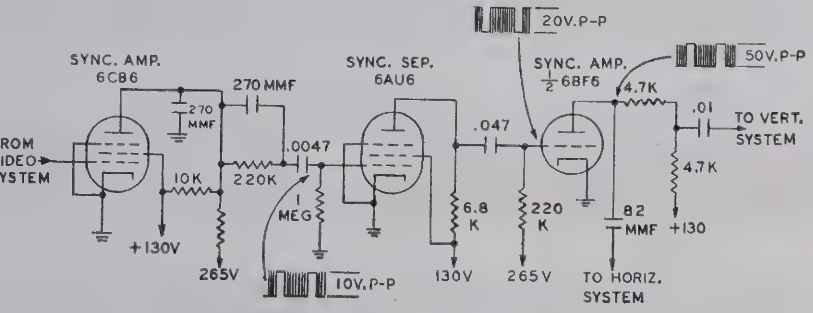


Figure 6—A sync separator system

As you can see, this sync injection method for locating intermittents will in every case isolate the trouble to a particular stage. From that point on the repair is very simple.

HOW TO USE THE TELEVISION ANALYST FOR TROUBLE SHOOTING LOSS OF AUDIO

This trouble shooting procedure for Audio I.F. Stages applies to intercarrier type of sets.

Let us assume there is no audio in a TV receiver. Within a couple of minutes we will find the defective stage by using the Television Analyst. Refer to Fig. 7. Assume a shorted screen bypass capacitor (5000 mmf) on the 4.5 mc Audio I.F. amplifier.

To check the speaker and audio output stage, inject the 400 cycle audio tone on the grid of the audio output tube (point A). A good tone will be heard. Then move the signal injection point to the grid of the audio amplifier (point B). Now use the 4.5 mc audio I.F. output with 400 cycle tone modulation and inject the signal at the plate of the sound I.F. amplifier (point C). You will still hear the tone signal indicating all the stages from this point to the loudspeaker are O.K. Now the 4.5 mc signal is injected on the grid of the 4.5 I.F. amplifier (point D), and the tone signal is no longer heard in the loudspeaker. This immediately tells you that the trouble is in this stage. A simple voltmeter test will discover the bad component, as no B+ or very low B+ will appear on the screen of this tube. It is always a good practice to check the screen dropping resistor under these conditions, to see if the excessive current has caused it to increase in value.

Make careful note where the yoke wires connect in the circuit. Also keep the yoke disconnected while the remaining tests are being made.

Next, the width coil is tested. To do this, it is disconnected completely from the circuit. Note the effect upon the boost indicator and hi voltage lights. If the width coil is defective, its removal from the circuit will bring back the high voltage. Under these conditions, both the B+ boost indicator and hi voltage indicator will light up. If the width coil is in series with the yoke in a particular circuit, remove the width coil at the same time the yoke is being removed. If the high voltage comes back again, one of these components is at fault. Reconnect the yoke first, using a connecting lead in place of the width coil. If the high voltage reappears, the width coil is the defective unit. This conclusion can be checked out by testing the yoke with the Shorted Turns and Leakage Test of the TV Analyst.

It is common practice to tap off pulses from various points on the secondary of the horizontal output transformer for use in the horizontal AFC and in keyed A.G.C. circuits. It may very well be that a defect exists in one of these auxiliary circuits which is having an adverse affect on the horizontal output transformer, loading it down and thereby preventing it from functioning normally. To determine if this is true here, disconnect one tap at a time, each time checking the indicators to see whether high voltage has returned. If the boost and high voltage indicators light up after one of these leads have been disconnected, then we know that the trouble exists in that particular auxiliary circuit. After this, it simply becomes a matter of tracking down the defect in the auxiliary circuit.

It may happen that even after all of the auxiliary components have been removed from the horizontal output transformer neither the boost or hi voltage indicators will light. This certainly points to a defective transformer and the TV Analyst has available the necessary tests to prove that the transformer is defective. At this point it might well be worthwhile to review the nature of defects that can occur in a horizontal output transformer. Some of the more obvious defects that can occur are open windings, shorts from one winding to another, hi resistance leakage from one winding to another or from a winding to the core of the transformer. The instrument provides a test for these conditions. There is another fault that is less obvious. A flyback transformer in operation is subject to both very high voltage pulses and relatively high temperatures. This can cause breakdown between turns in a winding resulting in one or two or more shorted turns within the winding of the transformer. These shorted turns represent a load on the flyback and a serious reduction in the "Q" of the whole system. As little as one shorted turn in a winding can result in an inoperative flyback system. These leakages and shorted turns can also occur in the horizontal windings of the deflection yoke and all of these tests are equally applicable to both. To test these components they must be completely disconnected from the circuit. To test for leakage and continuity the Calibrate control must be turned to the Leakage-Continuity position, which is fully counter clockwise. Connect the test leads to the Leakage Continuity test signal jacks and check continuity of the various windings. Presence of continuity is shown by a glow of the test indicator bulb. When measuring leakage between windings and from winding to core a glow of the test indicator shows that leakage is present. The leakage test will indicate leakage resistance from 0 to 10 megohms. Remove the leads from the Leakage-Continuity test jacks.

To test a transformer for shorted turns connect the shielded cable to the Flyback-Yoke test signal jack. Adjust the Calibrate control

NOTE: For the boost indicator to light up, R.F. pulses must be present on the plate of the horizontal output tube. This, in turn, means that boost B+ must be present, for without this additional voltage, any R.F. pulses produced will be too weak to light up the boost indicator. This makes the boost indicator doubly valuable because it provides a positive indication of whether the circuit is or is not operating.

3. If neither the boost indicator or the high voltage indicator light up, when the horizontal plate driving pulse is applied to the transformer, we proceed in the following manner:

   With a voltmeter, check the DC voltage at the plate of the horizontal output tube. We know that boost B+ is absent and this test is designed to reveal if any B+ is reaching the tube. If zero voltage is measured at this point, then either the voltage is being shorted out by boost filter capacitors C-3 and C-4 or the linearity coil L-1 is open. Short out the linearity coil and test the circuit again. If everything returns to normal, the linearity coil is open. If no change occurs we can presume that the coil is OK.

   Check capacitors C-3 and C-4 for any short or leakages. It should be noted here that a failure of the boost B+ voltage being applied to transformer terminal C will cause very little horizontal output signal because the output tube does not have enough plate voltage. This is because the boost B+ voltage is providing the power for the plate of the horizontal output stage.

   Returning to the damper circuit, if B+ voltage only is measured on the boost B+ line, it indicates that no high pulse voltage is being rectified and added to the B+ to develop a boost B+ voltage. There is another boost circuit defect which can cause this and that occurs when capacitor C-7 (Fig. 16) is shorted. For this condition, the B+ voltage will be applied from the plate of the damper tube to the cathode; there will be no rectification in the damper tube and hence no boost B+ voltage. This possibility can be checked by removing the damper tube from its socket and nothing whether the B+ voltage is still being measured at the cathode terminal of the damper tube socket. If the answer is yes, C-7 is shorted and should be replaced. However, if no voltage is present at the cathode of the damper tube with the tube out of its socket, then C-7 is not shorted and the damper tube can be returned to its socket.

   The role played by the two special indicator lamps provided with the TV Analyst demonstrates how useful they are in assisting the technician isolate a defect in the horizontal output circuit. Once their use becomes understood, they will be found to save many hours of service work.

4. We shall now demonstrate how to locate quickly a defect in the horizontal output system consisting of the transformer itself, the horizontal yoke or any of the associated components attached to these units. To check the horizontal yoke, it is only necessary to disconnect the yoke from the circuit so that any shorting effect a defective yoke might have on the rest of the circuit is removed. If now, with the plate drive signal applied to the horizontal output transformer, the boost indicator lights up as well as the hi voltage indicator showing that high voltage is being produced, then the defect in the set has been isolated to a shorted yoke. As a matter of fact, a vertical white line will appear on the screen of the TV receiver being tested, if the high voltage rectifier has been replaced in its socket. However, if the yoke is not the defective component, there will be no change in indications at this time.

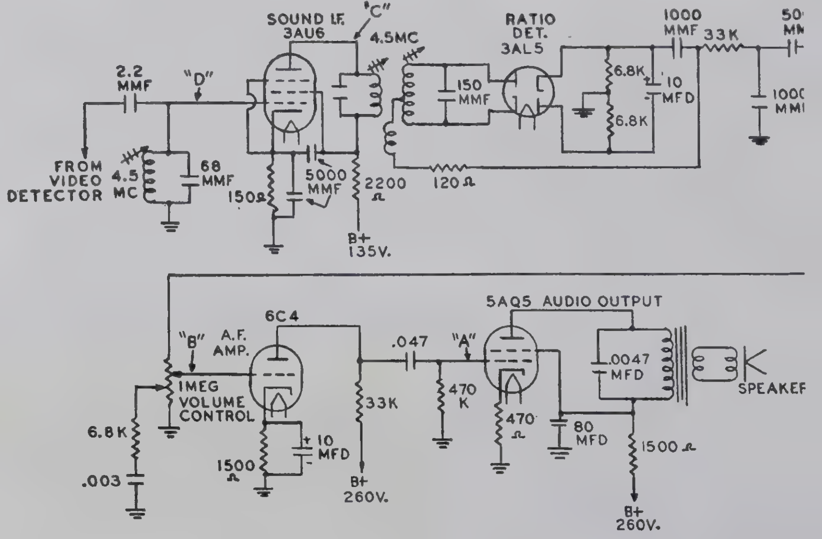


Figure 7—A typical TV audio system

HOW TO TROUBLE SHOOT SYNC AMPLIFIERS AND SYNC SEPARATOR STAGES

With the Television Analyst it is possible to quickly and thoroughly check the sync separator stages of any television receiver. To illustrate the procedure to follow, three representative sync separator sections will be discussed.

A fairly simple sync separator system is shown in Fig 8. This is seen to consist of the two triode sections of a 7AU7. We will assume that the picture is completely out of sync vertically and horizontally and we wish to check out these stages to determine if the trouble lies here.

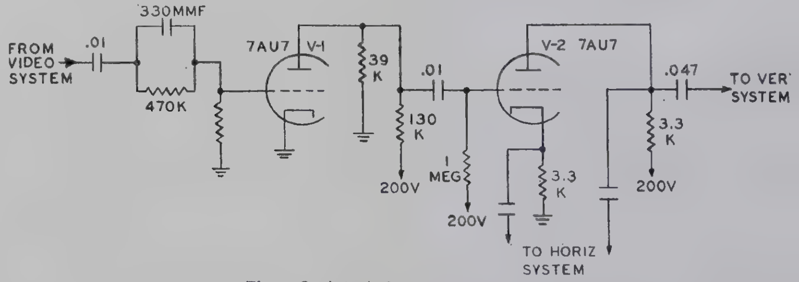


Figure 8—A typical sync separator system

As a first step, connect the Television Analyst to the receiver so that an image appears on the screen. The point of signal injection may be at the antenna terminals. It would be desirable not to inject the test pattern signal into the video amplifier stages because we might do this beyond the point where the sync signal take-off occurs. Rather than spend time looking for this point, inject the signal as indicated above.

The next step is to apply a composite sync signal from the Television Analyst to the grid (and chassis or B—) of V2, Fig. 8. It is important that the proper polarity sync signal be applied and ordinarily the technician would have to figure this out by checking through the schematic. With the Television Analyst such checking is not necessary. Simply apply the sync pulses from the Television Analyst to the control grid of V2. If the image on the screen locks into sync, we know the sync signal is passing through V2 and locking in the vertical and horizontal oscillators, and we have chosen the proper phase of sync signal.

If the picture on the screen remains out of sync then reverse the polarity of the sync signal by turning the Sync Amplitude Control to the other phase. This is the reason we do not have to know the proper sync signal polarity before hand. The Analyst permits us to try both phases by simply rotating the Sync Amplitude control. The picture will lock in now, if both deflection systems are operating normally.

If the picture still remains out of sync, the sync pulses are not reaching the vertical and horizontal sweep oscillators. In that case inject the sync pulses at the plate of V2 and repeat the procedure. The receiver should now sync indicating that the trouble must lie between the grid circuit and the plate circuit of V2.

If application of the test pulses at the grid of V2 does lock the picture in, shift the signal injection lead to the control grid of V1. Inability to sync the picture indicates a defect in V1 or its associated circuit. Voltage and resistance checks should then uncover the faulty component.

The level of the test sync pulses may be set at any point between 0 and 50 volts. In most instances, a mid-setting of the sync level control will serve satisfactorily. However, if you find that the full 50 volts peak-to-peak must be used in order to secure adequate synchronization, chances are there is something defective in the circuit. It may be that the pulses are not being properly amplified or that some component has radically changed its value, reducing the stage gain far below its normal figure. It is also well to keep in mind that the level of the injected sync pulses should be lowered whenever the signal lead is moved from plate to grid of a stage, or in going from the grid of one stage to the grid of a prior stage. In short, whenever you add more stages through which the pulse signal must pass, lower the output of the Sync Amplitude control.

Since the Sync Amplitude control is calibrated in volts, any level of signal required may be injected into a receiver sync system. A schematic may indicate that 35 volts peak-to-peak may be required to drive a particular stage. By setting the sync level control to 35 and injecting sync at this point you may determine if that stage will work properly with this level of signal.

A more elaborate sync separating system is shown in Fig. 9. The method of approach is still the same, however. That is, when a symptom of poor synchronization appears, you inject the composite sync signal from the Television Analyst at the plate and grid of each stage in the sync separation system, working from the stage closest to the deflection systems back to the stage that receives the initial video signal from the video system. The only thing to remember is that sync polarity must be reversed when switching from plate to grid. Failure to observe this precaution may erroneously lead you to believe that a stage is defective.

output stage from the horizontal oscillator. This coupling capacitor is frequently the cause of much difficulty in the horizontal output circuit. If C-2 becomes leaky or shorted, a positive voltage will be applied to the control grid of the horizontal output stage from the plate circuit of the oscillator. If the leakage resistance of C-2 is low enough, this could load down the horizontal oscillator circuit sufficiently to prevent any horizontal output or high voltage from being developed.

It is interesting to note, that if C-2 is leaky, with a fairly low resistance, applying the grid driving pulse to the horizontal output stage from the Analyst may not cause the high voltage to reappear since the shorted coupling capacitor may load down the Analyst circuit as well. To see if this is so, uncouple one side of C-2 and reapply the grid drive. If the high voltage now appears, capacitor C-2 should be changed.

2. If you find that injecting the signal from the TV Analyst at the plate of the horizontal output tube *does not* restore high voltage, then the trouble lies somewhere in the circuit *beyond* the horizontal output stage. NOTE: This is a *conclusive* test and it due *entirely* to the fact that the TV Analyst can take the place of the horizontal output amplifier.

The procedure to check out the output circuit with the instrument is as follows:

The cap lead is lifted from the top of the horizontal output tube; also the cap lead connecting to the high voltage rectifier is removed from its tube. As an added precaution, the high voltage rectifier tube is removed from its socket. The TV Analyst is then set to deliver a horizontal plate driving pulse. The lead from the Plate Drive terminal is connected to the cap lead that ordinarily goes to the horizontal output amplifier. Next, the B & K high voltage indicator light is attached directly to the *insulated* wire leading to the cap that connects to the high voltage rectifier. (See Fig. 15). The instrument and the television receiver are both turned on.

If the boost indicator light on the panel of the TV Analyst lights up, as well as the high voltage indicator, high voltage is being developed, boost B+ is present, and R.F. is being produced in the circuit. This is the condition that would generally be obtained when the set is working normally. In the present instance, the set is presumed to be defective; therefore, if such an indication is obtained, but there is no high voltage on the picture tube as indicated by lack of raster, it is possible that capacitor C-6 in Fig. 16 may be shorted, or the high voltage cable is not connected to the CRT. (We are assuming that all the tubes in the circuit including the picture tube have previously been checked before any testing with the instrument is begun.)

Another possible cause of no raster when the hi voltage indicator lights up is an open in the current limiting resistor R-4, preventing any high voltage from appearing on the picture tube. Each of these components can be checked individually to determine which is defective.

If the boost indicator lights up when the horizontal plate drive is applied to the transformer but the hi voltage indicator *does not* and there is no high voltage, then we have a definite indication that the trouble is in the transformer winding from point A to point B in Fig. 16.

Drive jack to the plate lead connection on the horizontal output transformer. Be sure the hi voltage indicator lamp is connected to the plate cap lead going to the hi voltage rectifier and that this lead is removed from the plate cap of the tube. Apply power to the receiver and observe the B+ boost indicator lamp on the front of the TV Analyst and the hi voltage indicator.

If both the B+ boost indicator and the hi voltage indicator lamps come on, they indicate the presence of boost voltage in the flyback system and hi level R.F. pulses in the hi voltage lead. Both of these indications tell us that the flyback system is now operating properly. The trouble must be in either the high voltage rectifier circuit or the output tube circuit. To eliminate the hi voltage circuit, reconnect the plate cap of the hi voltage rectifier tube, apply power to the receiver, and again observe the boost indicator and the hi voltage indicator. If both are lit this indicates that the high voltage rectifier circuit is O.K. We must still check whether the high voltage dropping resistor R-4 is open, preventing the high voltage from getting to the picture tube. If R-4 is O.K., then this proves conclusively that the trouble must be in the horizontal output tube circuit. It could be the screen resistor R-1, or by pass condenser C-1, or the cathode bias resistor R-3. (See Fig. 16)

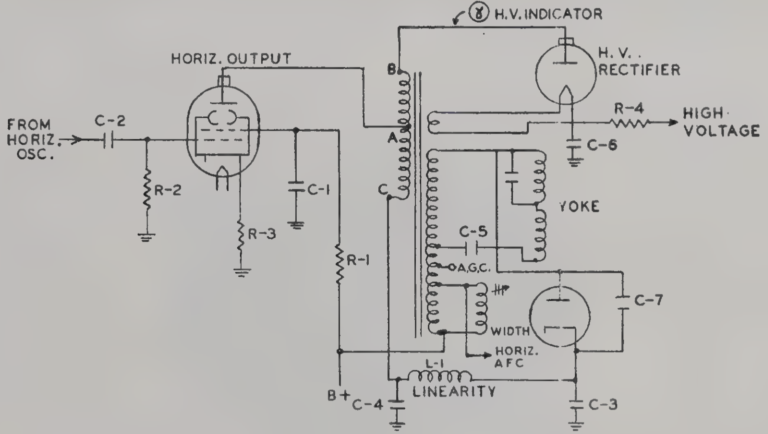


Figure 16—A horizontal output section using an isolation type of output transformer

Screen voltage is applied to the horizontal output tube through the screen dropping resistor R-1. There is also a bypass capacitor C-1 between the screen grid and ground. If resistor R-1 increases in value, the screen voltage will decrease, there will be less drive to the horizontal output transformer, and the picture width will decrease. If R-1 opens up, there will be no drive and no high voltage. Generally, if R-1 is open it will be found that capacitor C-1 has shorted and the excessive current drain has caused R-1 to burn out. In this case, both C-1 and R-1 should be replaced. As a matter of prudence, whenever R-1 has been found to increase in value substantially, it is good practice to change capacitor C-1 because it frequently is the cause of such resistance change.

In the grid circuit of the horizontal output stage, grid leak resistor R-2 and coupling capacitor C-2 bring the signal to the horizontal

---

As a precautionary rule, whenever you reach a point in the sync separator system where the injected pulses do not lock in the picture, try both polarity pulses. If you find that one polarity of sync pulse does lock in the picture, the stage is operating satisfactorily.

Within the past few years pentagrid tubes have been employed for the sync separating function, at the same time also helping to reduce the amplitude

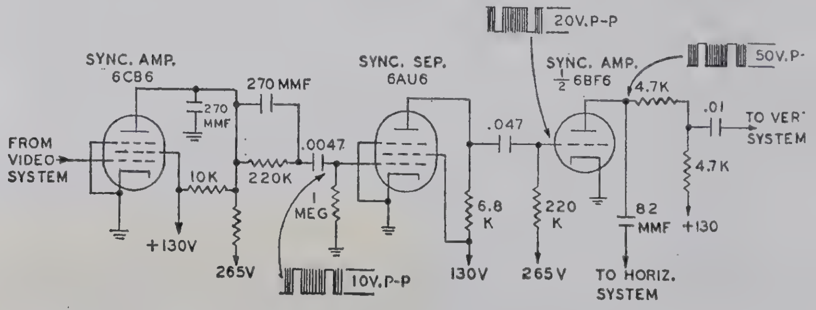


Figure 9—A more elaborate sync separator system

of any noise pulses that may be riding along with the signal. A typical circuit of this type is shown in Fig. 10. There is a 6BY6 pentagrid tube followed by a triode sync amplifier. A fairly small video signal with the sync pulses negative is fed to grid No. 1. The sync stabilizer control connected to the grid is adjusted so that tube current just flows with normal input signals.

An amplified version of the same video signal, with the sync pulses positive now, is obtained from the plate of the video amplifier and applied to grid No. 3 of the 6BY6. These sync pulses are strong enough to cause grid currents to flow in this circuit, charging capacitor C1 to a value approximately equal to the peak-to-peak amplitude of the applied pulses. In the interval between pulses, the negative voltage on grid No. 3 is high enough to prevent current from flowing through the tube. Thus, when the circuit is operating normally and a video signal is received, current will flow through the 6BY6 only during the sync pulse interval and only sync pulses will appear across the output load resistor.

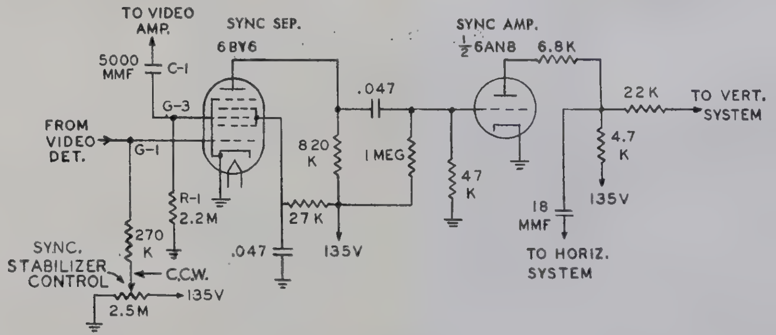


Figure 10
Sync Separator System

Consider now what happens when noise pulses appear at the same time. These noise pulses will be transferred first to grid No. 1 and if they are strong enough, they will cut this grid off. The same noise pulses, reversed 180°, will appear at grid No. 3. However, since grid No. 1 has cut the current off, nothing will appear in the plate circuit. In this way the 6BY6 suppresses any pulses which arrive stronger than the sync pulses. The pulses received from the 6BY6 by the following triode (½-6AN8) are then amplified and forwarded to the vertical and horizontal deflection systems.

To check out such a system when non-synchronization occurs, we would proceed as follows. With the set in operation, apply a composite sync pulse from the Analyst to the plate of the 6AN8 triode. If the picture locks in, reverse the polarity of the sync pulses and apply them to the grid of the same tube. If the circuit is functioning normally, the picture will again become synchronized. Now reverse the polarity of the applied sync pulses again and then touch the probe to grid No. 3 of the 6BY6. If the picture synchronizes, the sync separator system is functioning normally. If the circuit does not permit sync pulses to pass through, trouble in the 6BY6 stage is indicated. While the pulses are being applied to grid No. 3 of the 6BY6, rotate the sync stabilizer control in the receiver completely counter-clockwise. This places 0 volts on grid No. 1 and permits plate current to flow through the tube.

If injected test pulses at grid No. 3 synchronize the image but the receiver, without the injected sync pulses, still displays the same lack of synchronization, then the path between the 6BY6 and the preceding video system should be checked. Move your probe back component by component, until you reach the video system. An open capacitor, an open resistor or a shorted shunt capacitor will be readily uncovered by this point-to-point tracing method.

The sync pulses delivered by the Analyst are powerful enough to be applied directly to the integrator network leading into the vertical oscillator or to the capacitor leading into the horizontal phase detector. Thus you can trace the signal path from these two deflection systems all the way back to the video amplifier system of the receiver.

HOW TO TROUBLE SHOOT A.G.C. SYSTEMS

Locating defects in the A.G.C. (Automatic Gain Control) system in a television receiver represents one of the more difficult troubles that the technician is called upon to service. The first step that must be performed is the positive proof that the trouble lies in the A.G.C. system. Once this has been established the location of the defect will be relatively simple.

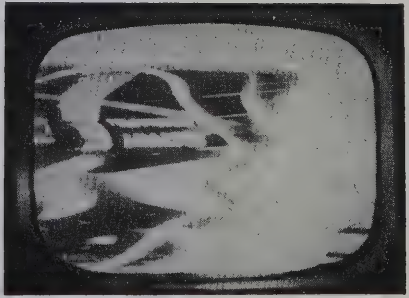


Figure 11—The appearance of an image produced when one of the video I.F. stages has been overloaded

Let us take as an example the case of a television receiver where the customer complains of a picture that seems to be negative and out of sync. The Television Analyst is connected to the antenna terminals of the receiver

plate of this stage. In essence, then, we can completely bypass the horizontal output tube. A second innovation is two indicator lights which further serve to pin-point troubles in the output transformer, or the high voltage network. The lights operate on a "go - no-go" basis, clearly revealing to the serviceman the presence or absence of certain hard-to-find troubles.

And last, but not least, sensitive leakage and shorted-turns tests can be made quickly and conclusively on yokes and horizontal output transformers, again providing the user with positive information.

Let us assume the receiver under test has no picture or raster and there is an absence of high voltage.

1. In order to determine whether the defeat lies in the horizontal oscillator stage or the horizontal output amplifier and the stages following it, proceed as follows:

   Using the Horizontal Grid Drive pulse available from the front panel of the TV Analyst apply this signal to the grid of the horizontal output tube. Connect the high voltage indicator lamp to the insulated wire going to the plate cap of the high voltage rectifier tube and remove the plate cap from this tube. See Fig. 15. Apply power to the receiver under test and observe the high voltage indicator lamp.

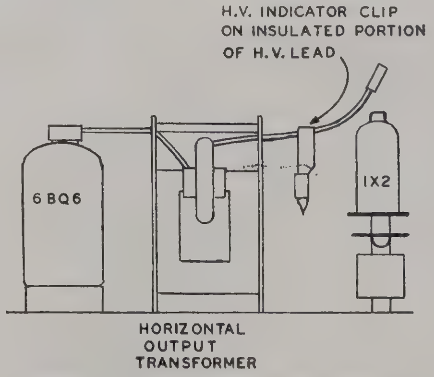


Figure 15—Connecting High Voltage Indicator

If the lamp glows this indicates the presence of high level R.F. pulses on this lead. Turn off the power and reconnect the high voltage plate lead to the rectifier tube and again apply power. If the high voltage rectifier circuit is O.K., the lamp should still remain lit and hi voltage should be present and deflection will be observed on the face of the CRT. Since the application of a driving pulse to the grid of the horizontal output resulted in restoring operation to the receiver the trouble definitely lies in the horizontal oscillator circuit. A few voltage and resistance checks will certainly bring the trouble to light.

Let us take another case where no hi voltage is again the trouble. Application of grid driving pulses do not restore hi voltage or deflection. This indicates that the trouble is not in the horizontal oscillator but that the difficulty lies in the output circuit of the receiver. Turn the Plate Drive Selector switch of the Television Analyst to the Horizontal position. Connect the ground lead of the instrument to chassis ground or B— and connect a test lead from the Plate tube. The vertical output tube itself is removed from the set. In sets where the heaters are series-wired, the filament terminals on the socket can be shorted out, so that all the other tubes in the series string will continue to operate.

We are now driving the output transformer from the vertical output stage contained within the TV Analyst. However, the B+ applied to this remote output stage in the instrument is derived from the receiver circuit itself. If vertical deflection is restored with this plate signal, the defect is in the vertical output stage, generally in the cathode circuit, assuming the tube to be good. If the vertical deflection is still missing then it indicates that either the vertical output transformer or the vertical windings of the deflection yoke are at fault.

We are assuming, in the preceding paragraph, that B+ is reaching the plate of the vertical output tube. This B+ is required by the TV Analyst to power its output tube. If no B+ should be present, no signal will be obtained from the PLATE DRIVE terminal. Hence, if application of the test lead from the instrument at the plate of the output stage does not produce vertical deflection, it would be desirable to check the voltage in this circuit to make certain it is present. Absence of the necessary voltage indicates an open circuit in the vertical output transformer winding, or an open resistor or shorted capacitor in the B+ network bringing this voltage to the vertical system.

To check the vertical windings of the deflection yoke, disconnect its wires from the circuit and connect them to the two test leads from the Vertical Yoke Test Signal jack and GROUND of the TV Analyst. If the yoke is good, vertical deflection of the picture tube image will result. The image will possess poor linearity and overlap or go back itself (Fig. 14) because the driving signal is a sine wave and not a sawtooth. However, we are not concerned here with checking linearity and, therefore, any indication of deflection would reveal the yoke to be good. The trouble now is definitely indicated to be in the vertical output transformer.

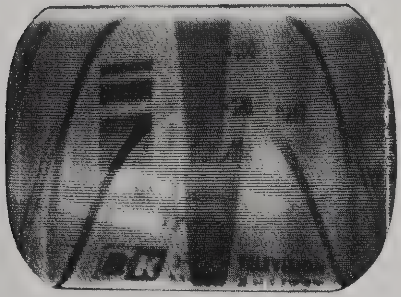


Figure 14—Sweep developed using vertical yoke test signal

TROUBLE SHOOTING HORIZONTAL DEFLECTION CIRCUITS

We come now to the horizontal circuit of a television receiver and it is here that the instrument offers the service technician several quick test features that will greatly simplify the task of servicing this section of the set.

One such outstanding feature is the ability to check the output circuit completely, both from the grid of the horizontal output tube and from the

and the test pattern signal tuned in. The displayed picture appears in Fig. 11. We must now take the video output signal from the Analyst and inject this signal to the grid of the 1st video amplifier. The result is viewed on the television receiver's picture tube. We observe that the displayed picture is satisfactory and we see the normal test pattern signal appears properly in sync. We must therefore conclude that the trouble does not lie in the video portion of the receiver. We now select an I.F. signal from the Television Analyst of the proper frequency and inject this signal to the grid of the 1st Video I.F. amplifier. This is point A in Fig. 12. Examination of the picture displayed on the receiver picture tube shows a negative picture that is out of sync. This is the same result that we saw in Fig. 11. Therefore, the trouble apparently lies in the I.F. portion of the receiver. We will now try to isolate the trouble to a specific stage.

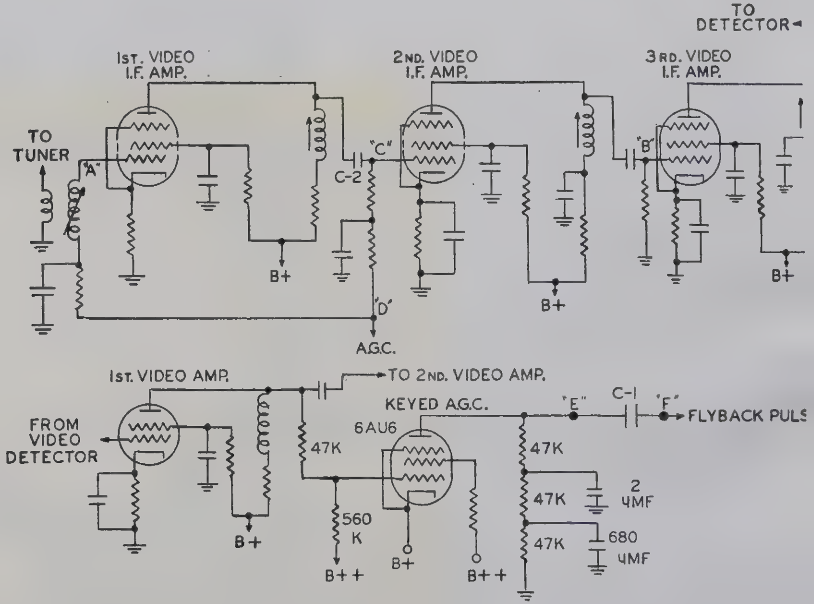


Figure 12—Video I.F. system and Keyed A.G.C. circuit

Since the trouble has been isolated to the video I.F. stages we will now examine each stage in turn to locate the difficulty.

Inject I.F. signal at point B which is the grid of the third video I.F. amplifier. We now observe on the screen that the picture appears to be normal. That is it is of the proper phase and is in sync. Notice that this stage is not controlled by A.G.C. The signal might be a little weak since very little gain is obtained using only one stage of video I.F. amplification. We now move our I.F. injection signal to point C, (the grid of the 2nd I.F. Amplifier) and again observe the result on the receiver picture tube. We now see that the receiver display is negative and out of sync. The trouble apparently is in the second video I.F. stage. Examination of the schematic of Fig. 12 will show that both the second I.F. stage and the first I.F. stage are subject to the controlling action of A.G.C. voltage.

Since the picture displayed in Fig. 11 could be caused by overload of the I.F. stage it might be wise at this point to determine the signal handling capabilities of these stages. By reducing the setting of the R.F.-I.F. Attenuator on the Television Analyst we are capable of lowering the level of the I.F. output to very low levels. As the amount of I.F. is reduced we reach a point where the picture on the customer's receiver no longer appears negative and is in sync. The picture will very likely be snowy as the signal is very weak at this point. We have now proved that the receiver is capable of handling a very weak signal but is certainly not able to handle a strong signal. This definitely points to an A.G.C. defect. The next step is to see if the I.F. strip will accommodate a strong signal if an external bias voltage is used to control the gain. With the I.F. signal injected at point C we connect a test lead from the bias supply of the Television Analyst to point D which is the A.G.C. feed point. A ground lead from the Television Analyst must also be connected. With the Negative Bias control set to —50 we see that the picture has completely disappeared. This is due to the fact that with this large bias we have cut-off the I.F. amplifier. As the bias voltage is reduced we will observe that a picture will begin to appear at around 6 to 12 volts. At about 3 or 4 volts we observe a normal picture and as the bias is reduced even further the sync begins to get unstable and then finally turns negative. These tests conclusively prove that this I.F. stage in the receiver is capable of handling without overload a wide range of signals running from the very weak to the very strong only if external bias control is exerted on the I.F. stage. This proves conclusively the trouble must be related to the A.G.C. circuits. Remove the negative bias lead.

The receiver under test employs a keyed A.G.C. system, which depends for its operation on a high level pulse which is derived from the horizontal deflection system. The absence of this pulse will render the A.G.C. inoperative, and cause the receiver to overload. We now disconnect capacitor C-1 at point E. Connect a test lead from the A.G.C. Keying Pulse jack on the Television Analyst and insert this high level pulse at the plate of the A.G.C. tube (E). We now see that the picture on the receiver screen has been restored to normal operation when I.F. signal is injected at point C, the grid of the 2nd I.F. amplifier tube. The trouble could be a defective C-1 or an open winding on the coil supplying the A.G.C. pulse. Reconnect C-1 and try inserting the A.G.C. pulse at point F. If proper operation results then C-1 is O.K. A resistance reading in this case will immediately show that the pulse coil is the defective component.

Another example of an A.G.C. trouble is as follows. A receiver having the same symptoms as the previous example is to be repaired Signal injection has isolated the trouble to the 2nd video I.F. stage. We find that by reducing the I.F. Attenuator control until the signal is at a very low level that a normal picture results. We now connect the negative bias supply to point D in Fig. 12 which is the A.G.C. bias buss. We find that adjustment of the Bias Control will not result in a normal picture at any setting of the control, with signal injection at point C at the I.F. frequency. These two tests indicate that the I.F. strip will amplify, as indicated by its ability to show a picture when the signal is very weak. However when the signal is very strong, a control voltage placed upon the A.G.C. buss has no effect on the stage as indicated by the use of the negative bias supply. This would indicate that if the A.G.C. system were operating normally it would have no effect on the stage gain and therefore the trouble must be peculiar to the 2nd video I.F. amplifier and must not relate to the control voltage that the A.G.C. system exercises. This points to the Grid circuit. A few voltage and resistance checks indicate a slight positive voltage on the grid of the 2nd I.F. amplifier. A positive voltage was found on the grid of the stage and a resistance check showed a leaky C-2.

In summary the receiver I.F. system must pass two tests to establish that the trouble is specifically in the A.G.C. First it must be capable of amplifying a very weak signal without distortion. Secondly, with a strong signal input and an external bias supply, control can be maintained. If both of the conditions are met then the trouble is definitely A.G.C. If only one test is passed then the trouble must be peculiar to the I.F. stage under test.

TROUBLE SHOOTING VERTICAL SWEEP CIRCUITS

The following steps should be taken when checking the vertical deflection systems. We will assume that the indications on the television receiver screen to be tested reveal that there is no vertical driving voltage being delivered to the vertical winding of the deflection yoke resulting in a horizontal line on the picture tube.

In order to isolate the defects in a receiver between the vertical oscillator stage and the vertical output stage, proceed as follows:

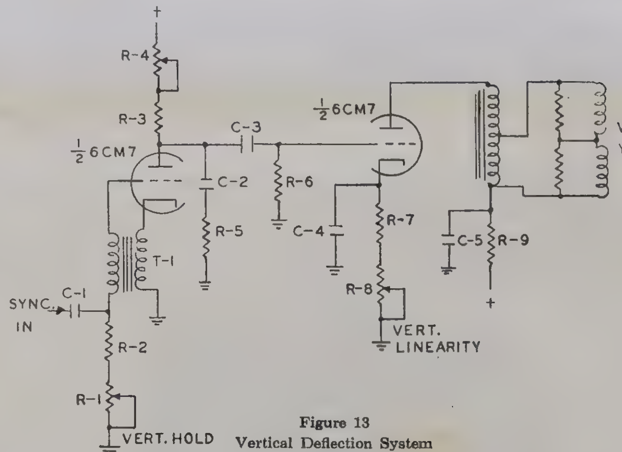


Figure 13
Vertical Deflection System

1. Using the Vertical Grid Drive pulse available on the front of the Television Analyst, apply this signal to the vertical output stage grid (see Fig. 13). If, when this signal is applied, the image develops vertical deflection, then we know that the proper driving signal is not being supplied to the output stage by the vertical oscillator. The defect is either in the oscillator itself or in the capacitor (C-3) coupling the oscillator to the output stage. However, if vertical deflection of the image does not occur when the signal is injected at the grid of the output stage, the defect is located somewhere between this grid and the deflection yoke.

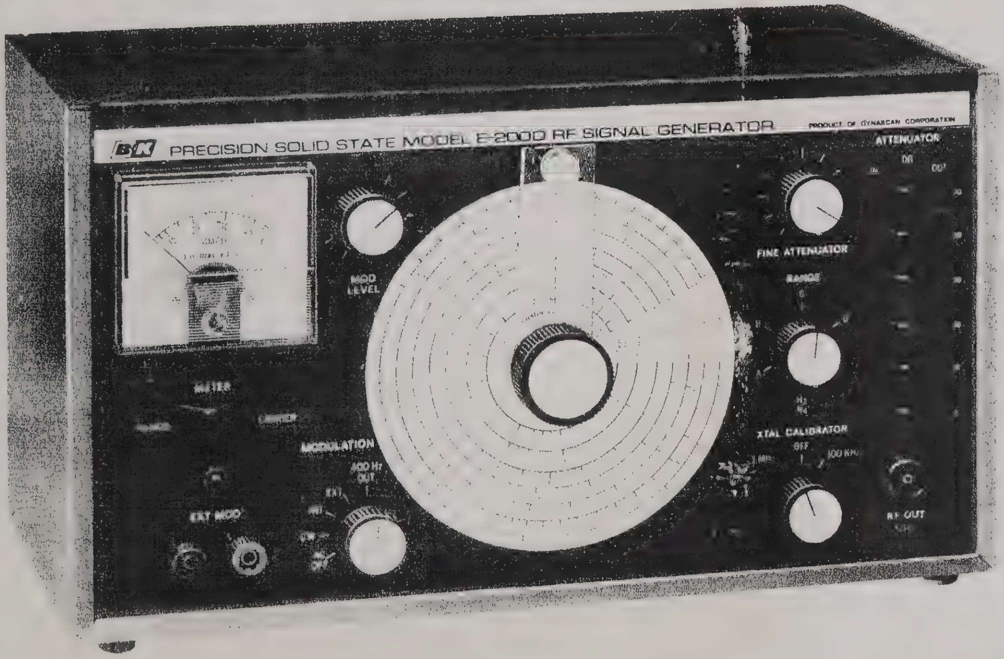
   The grid driving pulse signal may not necessarily result in linear deflection on the screen of the television receiver. However, we are primarily interested in the presence or lack of deflection. A closer approach to good linearity can be obtained by adjusting the linearity control in the receiver (R-8) in Fig. 13 and by adjusting the Vertical Drive Amplitude control located on the front of the Television Analyst. In all cases this control should be at maximum when first starting to troubleshoot vertical deflection systems.

2. Assuming that no vertical deflection results when the signal is injected at the grid of the output stage, inject the Vertical Plate Drive pulse from the Television Analyst at the plate of the vertical output

INSTRUCTION MANUAL

B&K Model E-200D

RF Signal Generator



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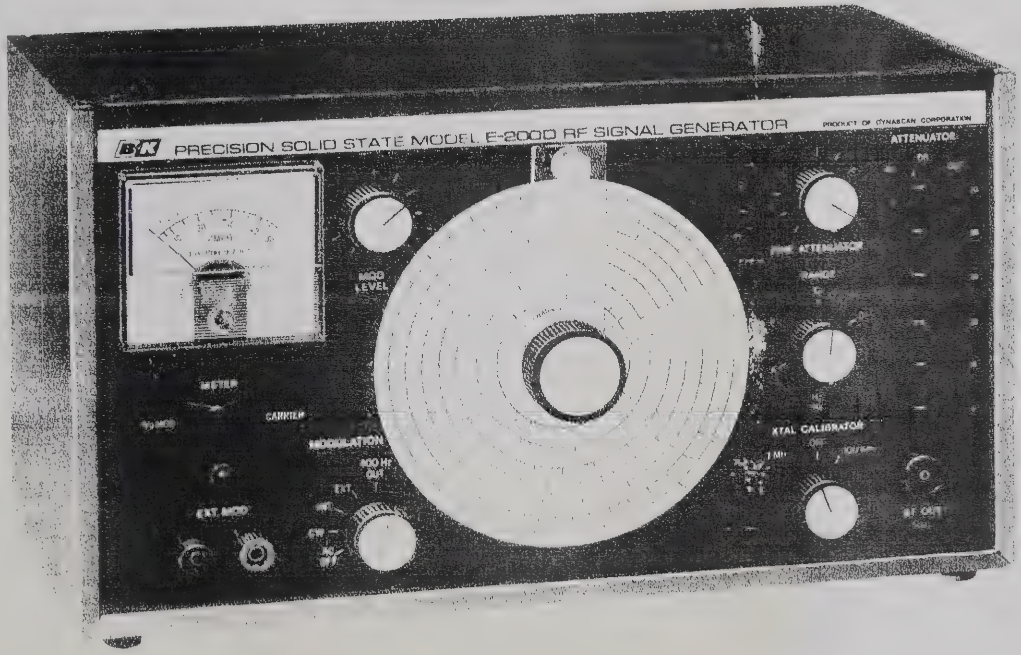

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In order to determine the type of test units that are needed we have been guided by letters and reports from technicians and engineers who use the equipment daily. Our field tests and studies have helped provide better and faster service techniques. Close contact has been maintained with the manufacturers of consumer products which our test units will be checking and trouble-shooting.

Key personnel in our company cut their eye teeth in the TV service business. This is why we have more "sensitivity" for the problems and conditions under which the test equipment will be used.

B & K product designs are constantly reviewed, and refinements are made or new models developed to meet advances in our industry and to fill your needs. We set our standards high so you can be assured that the B & K test instruments you buy represent advanced design, quality construction, and dependable long-term performance at a price you can afford.

If you have any comments or thoughts about our products, or test equipment in general, I would be delighted to hear from you.

Thanks for your confidence in B & K and we look forward to serving you for a long time to come.

Sincerely,

Carl Korn

Carl Korn
President

INSTRUCTION MANUAL

FOR

B & K/PRECISION

MODEL E-200D

R F SIGNAL GENERATOR

B & K DIVISION OF DYNASCAN CORPORATION
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B & K product designs are constantly reviewed, and refinements are made or new models developed to meet advances in our industry and to fill your needs. We set our standards high so you can be assured that the B & K test instruments you buy represent advanced design, quality construction, and dependable long-term performance at a price you can afford.

If you have any comments or thoughts about our products, or test equipment in general, I would be delighted to hear from you.

Thanks for your confidence in B & K and we look forward to serving you for a long time to come.

Sincerely,

Carl Korn

Carl Korn
President

SPECIFICATIONS

FREQUENCY RANGE		100 kHz to 54 MHz in five fundamental bands. 32 MHz to 216 MHz in two harmonic bands.
	BAND A	100 kHz to 370 kHz
	BAND B	370 kHz to 1400 kHz
	BAND C	1.4 MHz to 5.1 MHz
	BAND D	5.1 MHz to 16 MHz
	BAND E	16 MHz to 54 MHz
	BAND H_2	32 MHz to 108 MHz (harmonic)
	BAND H_4	64 MHz to 216 MHz (harmonic)
FREQUENCY ACCURACY		± 1.5% of highest frequency on any given band, usable to ± 0.1% with crystal calibrator.
MAXIMUM OUTPUT LEVEL		Output open circuited, meter uncalibrated:
	BAND A	3 V rms minimum
	BAND B	2 V rms minimum
	BAND C	0.6 V rms minimum
	BAND D	0.3 V rms minimum
	BAND E	0.3 V rms minimum
	BAND H_2	uncalibrated harmonic output
	BAND H_4	uncalibrated harmonic output
CALIBRATED OUTPUT		—106 dB (0.5 microvolt) to + 2 dB (126,000) microvolts) into 50-ohm load. Carrier meter covers —10 to + 2 dB range (reference 0 dB = 100,000 microvolts into 50-ohm load); attenuators extend range to —106 dB.
CALIBRATED OUTPUT ACCURACY		±1 dB 100 kHz to 54 MHz

ATTENUATORS	Six step attenuators of 20 dB, 20 dB, 20 dB, 20 dB, 10 dB and 6 dB (96 dB total) plus fully adjustable fine attenuator control.
MODULATION TYPE	CW or amplitude modulation
INTERNAL MODULATION	400 Hz ± 20% from bridged "T" two-stage oscillator; adjustable level.
EXTERNAL MODULATION SENSITIVITY	Approximately 1 V rms for 50% modulation at 400 Hz.
MODULATION METER	Reads 0 to 50% modulation for internal or external modulation; accuracy ± 5% from 100 kHz to 30 MHz.
CRYSTAL CALIBRATOR	Crystal calibration points every 1 MHz and 100 KHz (derived). Accuracy 0.05%. Built-in detector, amplifier and speaker for "zero beating".
400 Hz OUTPUT	Output of internal modulation oscillator available for external use at EXT MOD jacks. Level: 1.25 volts maximum Impedance: 5K ohms at maximum level. Distortion: Less than 0.5%
POWER REQUIREMENTS	117 VAC, 50/60 Hz, 6 watts
SIZE	12¾" wide x 7¼" high x 8" deep
SHIPPING WEIGHT	Approximately 14 pounds

B&K/PRECISION MODEL E-200D
R F SIGNAL GENERATOR

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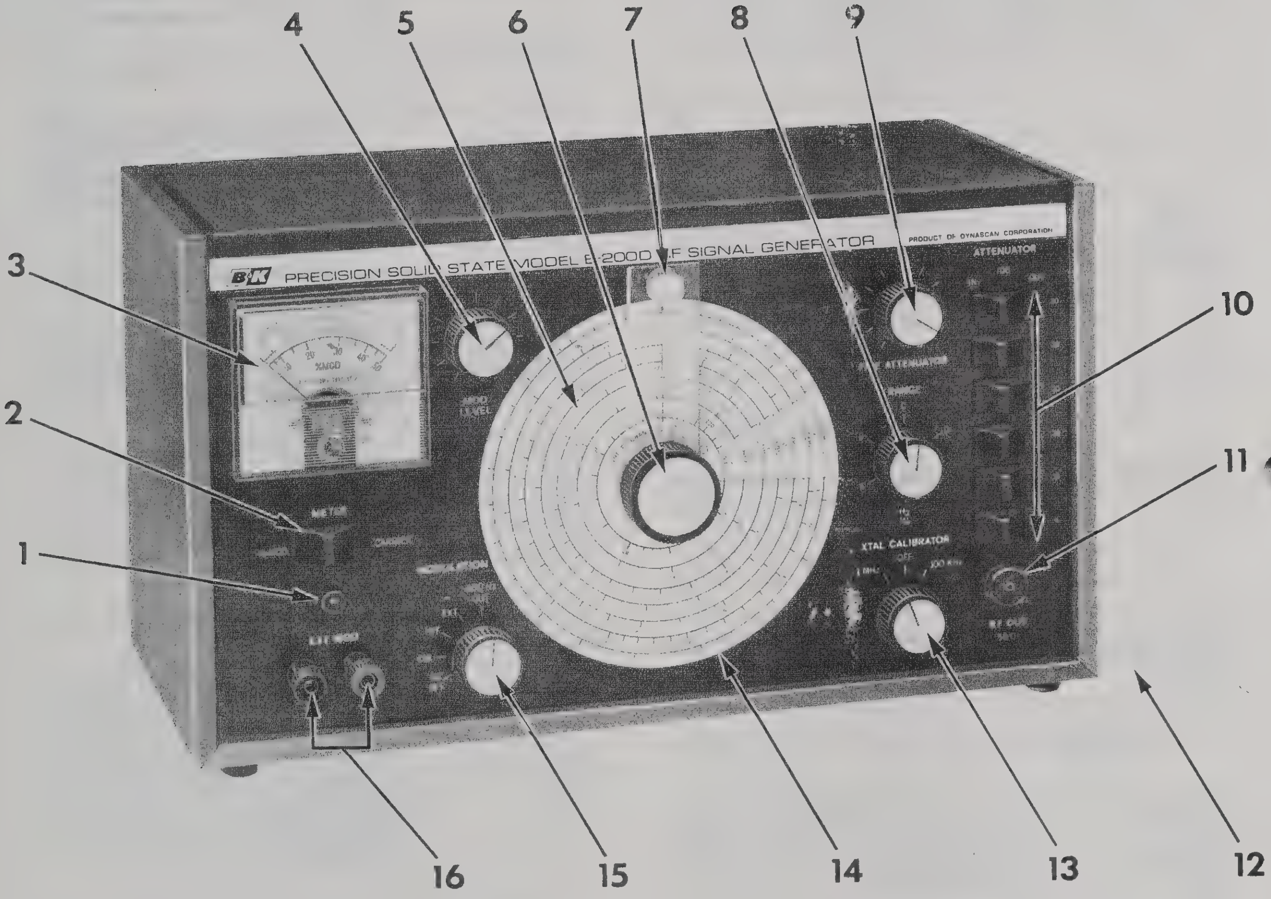


Figure 1. Operator's Controls and Indicators

FEATURES

WIDEST FREQUENCY RANGE	Continuous coverage from 100 kHz to 216 MHz in seven frequency bands (54 MHz to 216 MHz signals use harmonic output). No gaps in coverage. Covers AM broadcast band, FM broadcast band, amateur, short wave and two-way communications bands, and all VHF television channels, plus all i-f frequencies.
FULLY SOLID STATE	Uses 18 semiconductor devices for all the advantages of solid state technology; reliability, ruggedness, instant warm-up, low power consumption, no high voltage, light weight and compactness.
FULLY SHIELDED	Oscillators and attenuators are shielded to reduce "spray" radiation; a neccessity when testing and aligning high sensitivity receivers.
SINUSOIDAL OUTPUT	Sinusoidal rf output signal has very low distortion on fundamental output ranges to 54 MHz.
VERNIER SCALE TUNING	A 6.1 gear reduction ratio between the tuning knob and the dial allows the dial to be easily and accurately set.
EASY-TO-READ DIAL	A large circular two-color dial (15-inch circumference with seven separate frequency scales provides easy, accurate direct frequency readings. Key frequencies and frequency ranges are identified: Broadcast receiver i-f; FM i-f; TV i-f sound and video frequencies; FM band; VHF TV Video Carrier frequencies for all 12 VHF channels.

CALIBRATED OUTPUT LEVEL	A carrier level meter and step attenuators provide accurately calibrated output level measurement from —106 dB to +2 dB (0.5 uV to 126,000 uV) when using the 50-ohm terminated cable that is supplied with the instrument.
ADJUSTABLE MODULATION	A modulation percentage meter and modulation level adjustment permit calibrated modulation from 0 to 50%, with higher uncalibrated levels (up to 100%) possible.
FREQUENCY ACCURACY	A built-in crystal controlled oscillator, "zero beat" circuit and adjustable cursor marker provide dial accuracy of 0.1%.
INTERNAL MODULATION	Internal 400 Hz oscillator provides low distortion modulation voltage.
400 Hz OUTPUT	The output of the 400-Hz oscillator is available at the external modulation jacks for use as an audio test signal. Thus, the signal generator can be used for complete testing of both the rf and audio sections of a receiver. The level is fully adjustable from 0 to 1.25 volts rms.
PILOT LAMP EASE OF OPERATION	Lets you tell at a glance whether instrument is on or off. Controls and indicators are "operator designed". Related controls are grouped, lettering is easy to read and "explains" rather than confuses. Simplified control layout for calibration accuracy eliminates complicated conversion tables and graphs for precision frequency and output level settings.

OPERATING INSTRUCTIONS

PRELIMINARY SET-UP

1. Connect the plug of the ac power cord to a 117-volt, 50/60 Hz ac power outlet.
2. To turn on the signal generator, set the MODULATION switch **15** to the CW position. The pilot lamp 1 should light.
3. Set the XTAL CALIBRATOR switch **13** to the OFF position.
4. Set the RANGE switch **8** to the desired frequency range.
5. Set the dial **5** to the desired frequency with the frequency control knob **6**
6. Connect the rf output cable to the RF OUT jack **11**. The cable supplied with the signal generator is normally used. It contains a built-in 50-ohm termination. However, if the rf output signal is to be applied directly to a 50-ohm circuit, an unterminated rf cable should be used. Such a cable can be made from a length of 50-ohm coaxial cable (RG-58A/U) terminated in a microphone type female connector on one end and the desired connector or terminations on the other end.
7. Connect the rf output cable to the equipment being tested. Connect the black lead to the chassis first, then the red lead to the signal injection point.

PRECAUTIONS

A. When performing stage-to-stage measurements, always use a dc blocking capacitor between the red probe of the rf output cable and the circuit into which the signal is injected. This protects the attenuators of the signal generator from possible damage by the dc from the circuit under test. Trim the capacitor leads as short as possible, while still permitting adequate length for connections. The value of the blocking capacitor is dependent upon the frequency of the rf output signal. Suggested values are:
Ranges A and B: .1 uF, 400 V
Ranges C and D: .01 uF to .02 uF 400 V
Ranges E, H_2, H_4: 1000 pF

B. If the equipment into which the rf signal is being injected uses an ac powered, transformerless power supply, always use an isolation transformer between the 117-volt outlet and the equipment to prevent electrical shock and possible damage to the equipment. The equipment chassis becomes grounded through the rf signal generator when the rf cable is connected.

C. When connecting the rf output cable to equipment under test, always connect the black lead to the equipment chassis first. Otherwise, a transient voltage spike may occur when the connection is made that may damage transistorized equipment.

D. Use a dc blocking capacitor in series with the black lead of rf or 400-Hz output cables if other than chassis reference is used in equipment which has its chassis at earth ground. The black terminal of the EXT MOD jacks and the black probe of the rf cable are at earth ground potential through the 3-wire power plug. Serious damage to equipment could result by using a direct connection.

SETTING THE SIGNAL LEVEL

1. Be sure the output is terminated in a 50-ohm load.
2. Set the MODULATION switch **15** to the CW position.
3. Set the METER switch **2** to the CARRIER position.
4. Determine the amount of attenuation required to produce the desired output level (refer to the accompanying table). The desired output level may be in millivolts, microvolts, or dB, but must be converted to dB to correspond with the labelling on the controls. In this unit 0 dB = 100 millivolts into a 50-ohm load.
5. Place as many ATTENUATOR selectors **10** in the IN position as required to come within 0 to + 5 dB of the desired total attenuation. All the other ATTENUATOR selectors **10** must be in the OUT position.
6. Set the FINE ATTENUATOR control **9** for the additional attenuation, as indicated on the meter **3** (this should always be in the 0 to —5 dB region of the meter scale).
The total of all ATTENUATOR selectors and the meter reading equals the total attenuation below the 0 dB (100 millivolt) reference level.
7. Higher levels of output are possible but seldom required. Levels above + 2 dB must be measured with external equipment. At these higher levels, the meter **3** will peg, but no damage will occur since the meter is protected against overload damage. For output levels above + 2 dB, connect an rf voltmeter to measure the output signal level and adjust the FINE ATTENUATOR control **9** for the desired signal level.

NOTES

A. For greater accuracy, use an unmodulated signal level (MODULATION switch in CW position).

B. If the output is not terminated in 50 ohms, the output level is not calibrated. However, the meter and ATTENUATOR selectors still provide indication of relatively higher or lower level.

C. For ranges H_2 and H_4, which provide har-

OPERATOR'S CONTROLS AND INDICATORS

(Refer to Figure 1)

1. Pilot lamp—Lights continuously when signal generator is turned on.

2. METER switch

   % MOD position—Connects meter to measure percentage of modulation.

   CARRIER position—Connects meter to measure carrier (rf output signal) level.

3. Meter—Indicates carrier level in dB on top (red) scale or percentage of modulation on bottom (black) scale. Use the scale which corresponds to the METER switch position.

   NOTE

   The rf output must be terminated in a 50-ohm lead when using the carrier scale for calibrated output level.

4. MOD LEVEL control—Adjusts percentage of modulation for internal or external modulation. Adjusts level of 400-Hz tone output when MODULATION switch is in 400 Hz OUT position.

5. Dial—Indicates the frequency of the output signal. Use the scale which corresponds to the RANGE switch position.

6. Frequency control—Adjusts the dial frequency.

7. Cursor marker adjustment—Adjusts the cursor marker for highly accurate frequency readings when used with the crystal calibrator.

8. RANGE switch—Selects the frequency range for the output signal as follows:

   Range A —100 kHz to 370 kHz

   Range B —370 kHz to 1400 kHz

   Range C —1.4 MHz to 5.1 MHz

   Range D —5.1 MHz to 16 MHz

   Range E —15 MHz to 54 MHz

   Range H_2—30 MHz to 108 MHz

   Range H_4—60 MHz to 216 MHz

9. FINE ATTENUATOR control—Fine setting of output level.

10. ATTENUATOR selectors—Coarse setting of output level. Six individual attenuators of 20, 20, 20, 20, 10 and 6 dB permit steps from 0 to 96 dB. Each switch has two positions as follows:

    IN position—adds attenuation

    OUT position—removes attenuation

11. RF OUT jack — Connector for output signal. Mates with microphone type connector.

12. RF output cable—Connects output signal to equipment being tested or aligned. Cable contains 50-ohm termination. Use an unterminated cable if the output is being fed directly to a 50-ohm circuit.

13. XTAL CALIBRATOR switch

    1 MHz position—Provides crystal calibration at each multiple of 1 MHz.

    OFF position — disables calibration oscillators.

    100 KHz position—Provides crystal calibration points at each multiple of 100 kHz.

14. Speaker (behind dial)—Provides audible "zero beat" for crystal calibration procedure.

15. MODULATION switch

    AC OFF position—turns off unit. Unit is on in all other positions.

    CW position — Provides unmodulated CW (continuous wave) output.

    INT position — Provides 400 Hz internally modulated output.

    EXT position—Provides externally modulated output. The external modulation voltage is connected to EXT MOD jacks when using this switch position.

    400 Hz OUT position—Provides 400-Hz output at the EXT MOD jacks.

16. MOD jacks—Input jacks for external modulation and output jacks for 400-Hz tone. Universal binding post type jacks accept banana plug, meter leads, spade lugs, etc. Black post is grounded, red post is audio high.

SETTING MODULATION

1. To use 400 Hz internal modulation, set the MODULATION switch **15** to the INT position.
   To use external modulation, connect the audio signal to the EXT MOD jacks **16** (black = ground, red = audio high) and set the MODULATION switch **15** to the EXT position.
2. Set METER switch **2** to the % MOD position.
3. Adjust the MOD LEVEL control **4** for the desired percentage of modulation as indicated on the meter **3**.

The meter indicates percentage of modulation from 0 to 50%. Typical modulation for testing is 30%. Uncalibrated modulation greater than 50% is possible. Maximum modulation with the MOD LEVEL control fully clockwise is approximately 100%.

To determine per cent modulation for levels greater than 50 per cent, an oscilloscope may be used, provided the bandwidth of the oscilloscope is sufficient to observe the modulated signal. Refer to Figure 3. The voltage A is one-half the unmodulated carrier level. The level B is the modulation depth measured from the original unmodulated carrier level. The ratio of B to A is used to determine per cent modulation:

Modulation, per cent, = B/A x 100

CRYSTAL CALIBRATION

The crystal calibrator uses the "zero beat" method to obtain a high degree of frequency dial accuracy. It operates as follows. A crystal controlled oscillator produces calibration signals that beat with the signal generator output. When the two frequencies are separated by only a small amount, the difference frequency is in the audio range and is heard as an audio tone (whistle) in the speaker. As the signal generator output frequency approaches the crystal oscillator frequency, the pitch of the audio tone decreases. When both signals are the same frequency, a "zero beat" occurs where no tone is heard in the speaker. If the adjustable oscillator is tuned in either direction from the "zero beat" frequency, the tone is heard. The crystal controlled oscillator is rich in harmonics, which provides calibration points at each multiple of the crystal frequency.

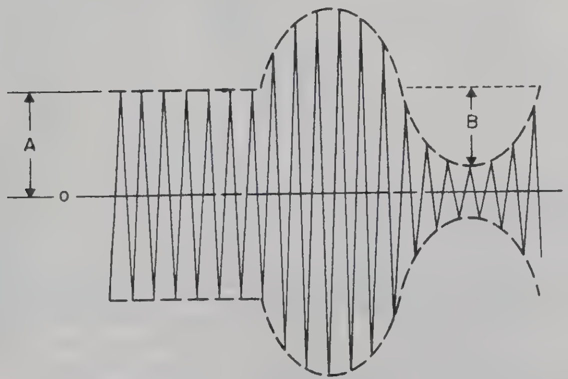


Figure 3. Amplitude Modulation Percentage

NOTE

Set the output level before setting the frequency. Although the oscillator and attenuators are isolated by an emitter follower, slight frequency pulling can occur when the FINE ATTENUATOR is adjusted or step attenuators are switched in and out.

1. Set the cursor marker **7** to the center of its travel.
2. Select the desired frequency range with the RANGE switch **8**.
3. Set the dial **5** to the desired frequency with the frequency control **6**.
4. For ranges A, B and C, set the XTAL CALIBRATOR switch **13** to the 100 KHz position. For ranges D, E, and H_2 H_4, set the XTAL CALIBRATOR switch **13** to the 1 MHz position. (The 1 MHz position can also be used for range C, but the calibration points are widely separated.)
5. Set the dial **5** to the nearest calibration frequency as follows:
   If the XTAL CALIBRATOR switch is in the 100 KHz position, calibration points occur at each multiple of 100 kHz. If the XTAL CALIBRATOR switch is in the MHz position, calibration points occur at each multiple of 1 MHz.
   On range H_2 calibration points occur at multiples of 2 MHz, and on range H_4 calibration points occur at multiples of 4 MHz.
6. Carefully set the dial **5** to obtain the "zero beat". A properly set "zero beat" is identified as a very precise dial setting where rocking the dial in either direction will produce a whistle.

   NOTES

   A. At higher frequencies, the "zero beat" whistle is progressively weaker. Listen carefully for the "zero beat" whistle at the high end of range C and the high end of ranges E, H_2 and H_4.

   B. Some less predominant beat frequencies are audible at other than calibration points. Disregard theses tones and use only multiples of 100 kHz or 1 MHz.
7. Carefully set the cursor marker **7** to exactly align with the calibration frequency mark on the dial. The dial is now calibrated for all frequencies near the calibration point.
8. Set the XTAL CALIBRATOR switch **13** to the OFF position.
9. Carefully readjust the dial **5** to the desired output frequency.

EXAMPLE

Desired Condition: Calibrated 455 kHz output
Procedure:
RANGE switch ....B
XTAL CALIBRATION switch ....100 kHz
Dial ....50 (500 kHz); as read on scale B (nearest calibration point)
Tune dial in vicinity of 50 for "zero beat"
Adjust cursor marker to exactly 50 on dial
XTAL CALIBRATION switch ....OFF
Set dial to ....45.5 (455 kHz)

monic signals, the meter reads the level of the fundamental (Range E signal) only. The level of the harmonic is not indicated on the meter, but is proportional to the level of the fundamental signal.

DESIRED CONDITION

output signal level = 25 microvolts

PROCEDURE

- from table 25 microvolts = —72 dB total attenuation

  —20 dB
  —20 dB
  —20 dB
  —10 dB
  —2 dB

  —72 dB

- set three of the 20 dB ATTENUATOR selectors to the IN position (any three may be used)
- set the 10 dB ATTENUATOR selector to the IN position
- set the FINE ATTENUATOR for a meter reading of —2 dB

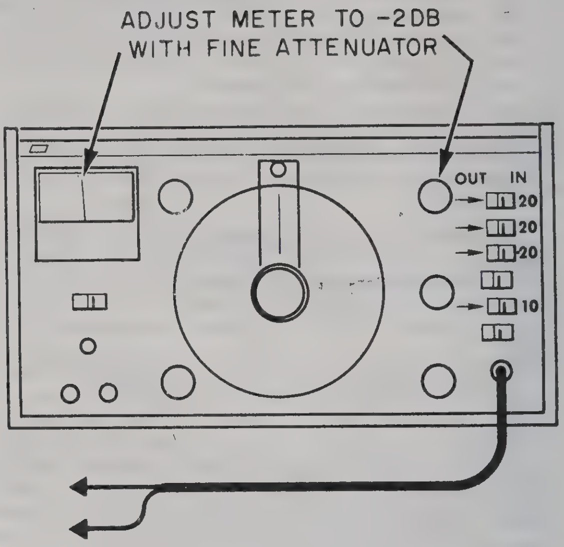
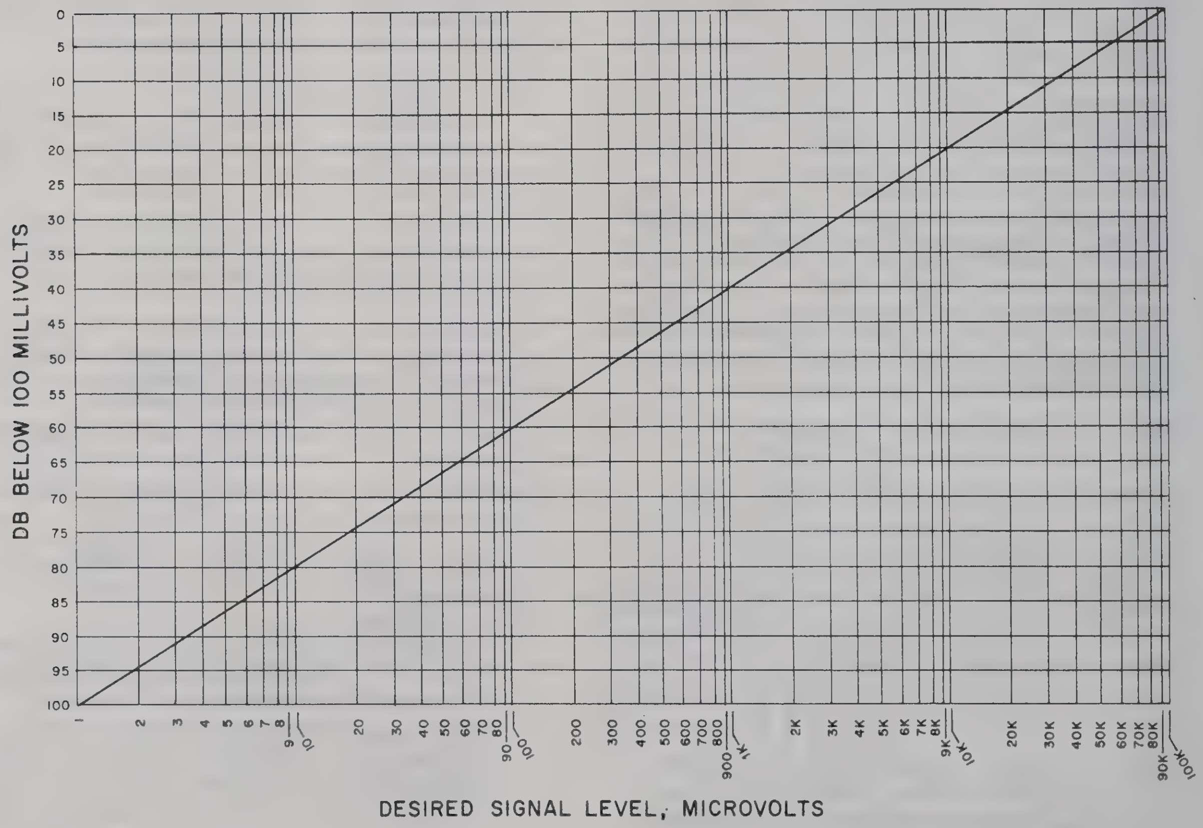


Figure 2. Typical Example, Setting Signal Level



DB-to-Voltage Conversion Table

6. Modulate the signal generator output with a 400-Hz audio signal at 30% modulation.

   Set the rf signal generator controls as follows:
   MODULATION switch ....INT
   METER switch ....% MOD
   MOD LEVEL control...Adjust for 30% reading on the modulation meter

7. Set the controls on the signal generator to provide the minimum signal level that will provide a usable meter reading on the VTVM.

   METER switch ....CARRIER

   FINE ATTENUATOR ....Adjust for 0 dB on carrier meter.

   ATTENUATOR selectors ....Place as many in the IN position as required to obtain proper signal level.

   A satisfactory level should be a comfortable listening level in the speaker. The volume control may be readjusted if audio output is excessive with the rf signal fully attenuated.

8. Starting at the detector and working toward the antenna, adjust each of the i-f coils for maximum meter reading on the VTVM (in Figure 4, adjust L4, L3, then L2 in that sequence). Reduce the signal generator output level as required to maintain suitable meter reading and speaker volume. REPEAT THE ADJUSTMENTS UNTIL NO FURTHER IMPROVEMENT CAN BE OBTAINED.

   If the radio is badly misaligned, it may be necessary to inject the signal directly into the 2nd i-f amplifier to adjust L4, then move the injection to the input of the 1st i-f amplifier to adjust L3, and to the input of the converter to adjust L2.

9. Enable the local oscillator by removing the short from the oscillator coil.

10. Move the red probe of the rf cable to the antenna input of the receiver.

    If the radio uses a ferrite loopstick attenna, wind several loops of insulated wire into a coil, connect the probes of the rf cable to the two ends of the coil, and place the coil in the vicinity of the antenna (See Figure 5). The signal radiated by the coil will be picked up by the antenna. Do not place the coil so close to the antenna that overcoupling will detune the antenna circuit.

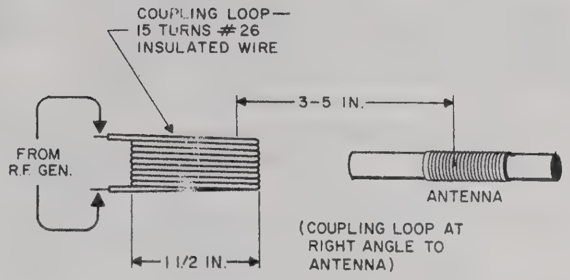

COUPLING LOOP— 15 TURNS #26 INSULATED WIRE
3–5 IN.
FROM R.F. GEN.
ANTENNA
(COUPLING LOOP AT RIGHT ANGLE TO ANTENNA)
1 1/2 IN.

Figure 5. Signal Injection Coupling Loop for Ferrite Loopstick Antenna

11. Tune the receiver to 600 kHz.

12. Set the signal generator to 600 kHz as follows:
    RANGE switch ....B
    Dial ....60 (scale B)
    If necessary, readjust the signal level.

13. Adjust oscillator coil (L1) for maximum meter reading on the VTVM.

14. Tune the receiver to 1600 kHz.

15. Set the signal generator to 1600 kHz (1.6 MHz) as follows:
    RANGE switch C
    Dial ....1.6 (scale C)
    If necessary, readjust the signal level.

16. Adjust the oscillator trimmer capacitor (C2) for maximum meter reading on the VTVM.

17. Tune the receiver to 1400 kHz.

18. Set the signal generator to 1400 kHz (1.4 MHz) as follows:
    RANGE switch C
    Dial ....1.4 (scale C)
    If necessary, readjust the signal level.

19. Adjust the antenna trimmer capacitor (C1) for maximum meter reading on the VTVM.

20. Repeat steps 11 through 19 until no further improvement can be obtained.

ALIGNING FM BROADCAST BAND RECEIVER

(Refer to Figure 6)

NOTES

A. An FM signal generator is not required for proper alignment of an FM receiver. Excellent results may be obtained by injecting an unmodulated carrier signal from an rf signal generator and measuring the dc voltage output of the ratio detector (discriminator in many receivers).

B. For FM receivers and tuners, it is important to follow the manufacturer's procedure. However, the accompanying procedure is very typical and applies to many FM receivers (and the FM portion of AM-FM radios). In all cases, the procedure exemplifies the use of the rf signal generator for alignment.

ALIGNING AM BROADCAST BAND RECEIVERS

(Refer to Figure 4)

NOTES

A. For best results, always follow the manufacturer's alignment procedure explicitly. However, if such procedure is not available, or only a condensed procedure is available, the following general instruction should be helpful for aligning most AM broadcast band radios (and the AM portion of AM-FM radios). Since circuit designs vary widely, some of the circuits shown may not be included in all radios, and other radios may have additional circuits or a different arrangement of components.

B. If a transformerless ac-dc receiver is to be aligned, be sure to use an isolation transformer.

C. When preparing to align transistorized receivers, turn off all equipment while connections are being made or being removed to eliminate the possibility of transient voltage spikes which could damage transistors.

D. Keep the signal output level of the signal generator low. Use just enough signal to provide a usable reading on the alignment meter. High signal levels may overdrive amplifiers, resulting in improper alignment. As the receiver is aligned, the meter reading increases. Continuously reduce the signal generator output level, as required, to maintain approximately the original meter reading.

1. Disable the local oscillator as recommended by the radio manufacturer, or short across the oscillator coil.
2. Set the volume control of the receiver to the normal listening level.
3. Connect a VTVM to measure the audio voltage across the speaker voice coil. Use a convenient ac voltage scale.
4. Connect the rf cable from the signal generator to inject a signal at the input of the converter. First, connect the black probe to signal ground near the signal injection point, then connect the red probe through a series dc blocking capacitor to the converter input.
5. Set the signal generator to the receiver i-f frequency. Most AM broadcast band receivers use a 455-kHz i-f signal, except automobile radios, some of which use a 262-kHz i-f signal.

To set the rf signal generator at 455 kHz:

RANGE switch ....B
Dial ....45.5 (scale B)

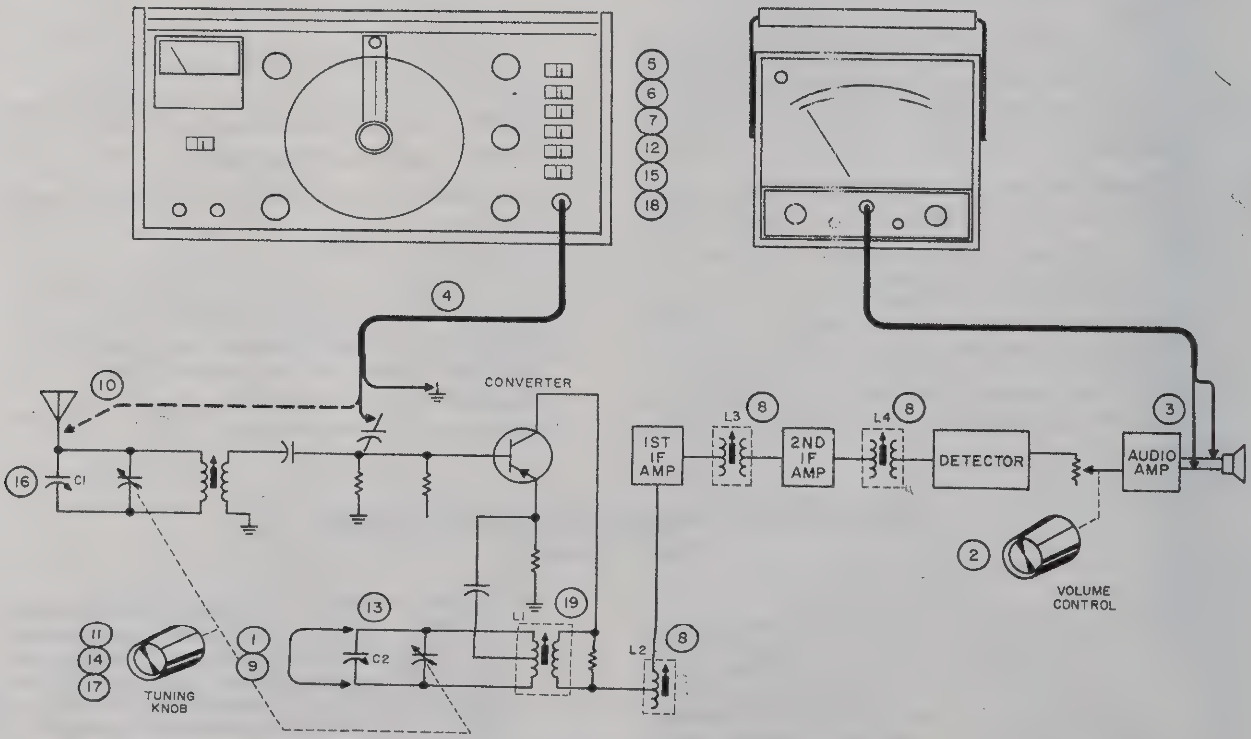


Figure 4. Typical AM Broadcast Band Receiver Alignment

the antenna, align each i-f coil for maximum meter reading on the VTVM (in figure 6, adjust L6, L5, and L4 in that order). Reduce the signal generator output level as required to maintain a small meter reading. REPEAT THE ADJUSTMENTS UNTIL NO FURTHER IMPROVEMENT CAN BE OBTAINED.

If the radio is badly misaligned, it may be necessary to inject the signal directly into the 2nd i-f amplifier to adjust L6, then move the injection to the input of the 1st i-f amplifier to adjust L5, and to the input of the mixer to adjust L4.

8. Change the VTVM connections to measure the voltage at test point B. Again refer to the manufacturers' data for the exact location of test point B and the reference point to be used for this measurement.
9. Adjut the secondary coil (L7) of the ratio detector (discriminator) for an exact zero meter reading. Adjusting the coil in one direction must cause a positive dc voltage, and a negative dc voltage if adjusted in the other direction. Use the most sensitive scale of the VTVM for the most accurate reading.
10. Check ratio detector (discriminator balance. If unbalanced, repeat i-f alignment until balance or near balance can be obtained.

    Balance shou'd be checked as follows:

    a. Set the signal generator dial equal amounts above and below the 10.7 MHz i-f center frequency. Refer to the radio manufacturer's data for the specific amount, usually approximately 100 kHz. If 100 kHz is used, dial
    b. Read the voltage on the VTVM at each of the frequencies. The voltages must be equal and of opposite polarity.
    c. Use care in setting the dial of the signal generator an equal amount above and below the center frequency, and in reading the VTVM. Inaccuracies will result in unsatisfactory alignment.
11. Enable the local oscillator by removing the short across the coil.
    the coil.
12. Move the rf cable to the antenna terminals of the radio.
13. Reconnect the VTVM as in step 3.
14. Tune the radio to 90 MHz.
15. Set the signal generator to 90 MHz.

    RANGE switch ....H_2
    Dial 90

    Select a signal level that will produce a small voltage reading on the VTVM.
16. Adjust the oscillator, mixer and antenna coils L3, L2 and L1 for maximum meter indication on the VTVM.
17. Tune the radio to 108 MHz.
18. Set the signal generator to 108 MHz. If necessary, readjust the output level for a usable meter reading.
19. Adjust rf trimmer capacitors C1 and C2 for maximum meter indication on the VTVM.
20. Repeat steps 13 through 19 until no improvement can be obtained.

ALIGNING TELEVISION RECEIVERS

SOUND I-F

The rf signal generator may be used to align the sound i-f section of television receivers. The procedure is essentially the same as for the i-f portion of FM broadcast band receivers except that a 4.5-MHz i-f signal is used.

VIDEO I-F

Proper alignment of the video i-f section requires close adherence to the television set manufacturer's alignment procedure. Due to the wide bandwidth involved, stagger tuning is required. Refer to the manufacturer's instructions for the frequency at which each coil is to be tuned. Although the rf signal generator can be used for such alignment by setting it to the specified frequency for each coil and tuning the coil for maximum output from the i-f section, a more common and preferable method is to use a sweep generator.

Set up the sweep generator to inject a signal into the i-f section which covers the entire video i-f spectrum and display the output of the i-f section on an oscilloscope. The rf signal generator is used as a marker generator. The marker generator creates a "pip" (visible marker) on the oscilloscope pattern. By adjusting the frequency of the rf signal generator, the marker can be moved to any required position, thus measuring data such as the lower bandpass limit, upper bandpass limit, adjacent channel rejection, effectiveness (proper adjustment) of trap circuits, and any other data required. Since the rf signal generator is continuously adjustable, all points on the video i-f response curve can be checked for waveshape configuration and bandwidth. Likewise, chroma and sound response curves may be checked.

TUNER ADJUSTMENT

The harmonic output of the rf signal generator in ranges H and H_1 covers the VHF television spectrum. This output can be used as a marker signal when aligning VHF tuners with a sweep generator. Refer to the television manufacturer's instructions for the proper alignment procedure.

C. If a transformerless ac-dc receiver is to be aligned, be sure to use an isolation transformer.

D. When preparing to align transistorized receivers, turn off all equipment while connections are being made or being removed to eliminate the possibility of transient voltage spikes which could damage transistors.

E. Keep the signal output level of the signal generator low. Use just enough signal to provide a usable reading on the alignment meter. High signal levels may overdrive amplifiers resulting in improper alignment indications. As the receiver is aligned, the meter reading increases. Continuously reduce the signal generator output, as required, to maintain approximately the original meter reading.

1. Disable the local oscillator as recommended by the radio manufacturer, or short across the oscillator coil.
2. If the radio has an AFC switch, place it in the OFF position.
3. Connect a VTVM to measure the dc voltage output of the ratio detector (discriminator in many receivers) at test point A. Use a low range (1.5 volt) dc voltage scale.

NOTE

Many variations in circuit design cause the reference point to vary widely. Most often, chassis ground is *not* the reference point for this reading. Refer to the manufacturer's instructions for the exact location of test point A and the reference point.

4. Connect the rf cable from the signal generator to inject a signal at the input of the mixer (converter in some radios). First connect the black probe to the signal ground near the signal injection point then connect the red probe through a series dc blocking capacitor to the mixer input.
5. Set the controls on the signal generator to provide an unmodulated carrier signal at precisely 10.7 MHz as follows:

   MODULATION switch ....CW

   RANGE switch C

   Crystal calibrate at 11 MHz (see crystal calibration instructions).

   XTAL CALIBRATION switch ....OFF

   Dial 10.7

6. Set the controls on the signal generator to provide the minimum signal level that will provide a usable meter reading on the VTVM.

METER switch	CARRIER
FINE ATTENUATOR	Adjust for 0 DB on carrier meter.
ATTENUATOR selectors	Place as many in the IN position to obtain proper signal level.

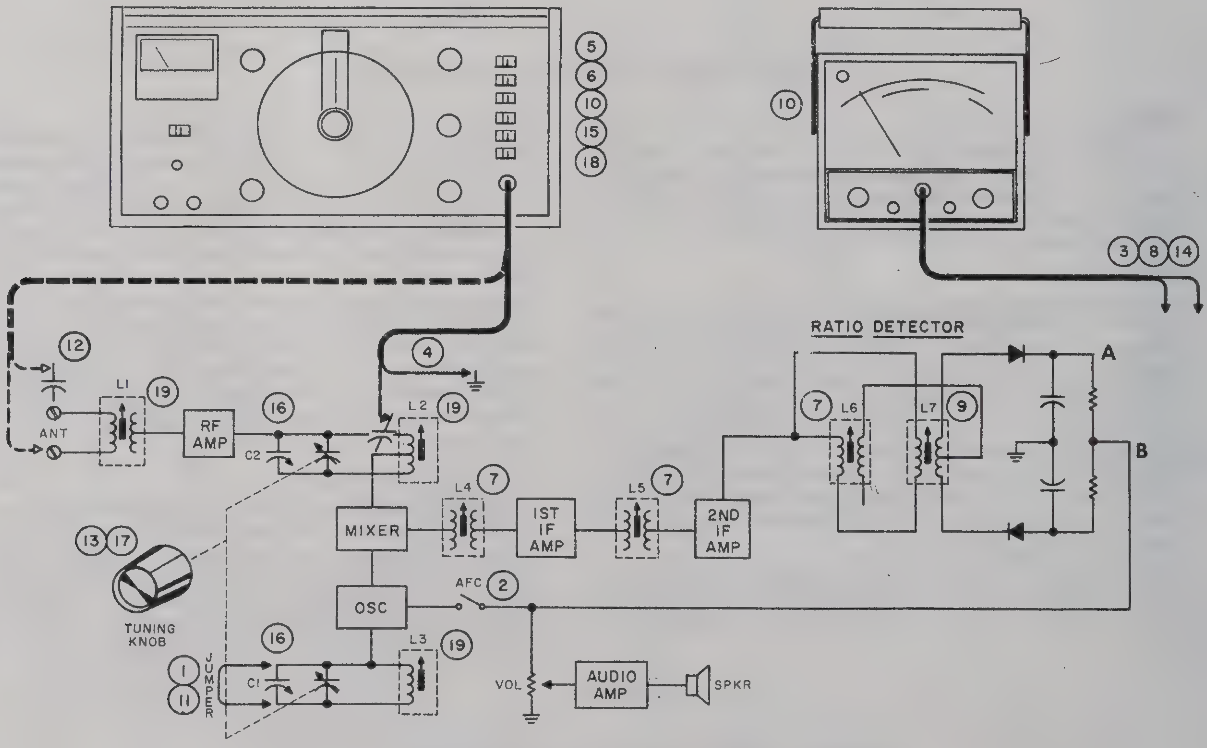


Figure 6. Typical FM Broadcast Band Receiver Adjustment

7. The audio section testing is completed, and the 400-Hz output is no longer required. Remove the test leads from the EXT MOD jacks and continue by testing the i-f section.

8. Connect the rf cable from the signal generator RF OUT jack to the input of the detector. Use a dc blocking capacitor in series with the red probe and connect the black probe to chassis.

9. Set the controls on the signal generator to produce a modulated 455-kHz i-f signal output as follows:

MODULATION switch	INT
METER switch	% MOD
MOD LEVEL	30% (as indicated on modulation meter)
RANGE switch	B
Dial	45.5 (scale B)
METER switch	CARRIER
FINE ATTENUATOR	0 dB on carrier meter
ATTENUATOR selectors	Set as many to IN as possible with the 400-Hz tone audible in the speaker

   If no tone is heard, the detector is defective.

10. Move signal injection to the input of the 2nd i-f amplifier. The gain of the stage should cause a louder tone from the speaker than in step 9. Reduce the signal level to maintain a comfortable listening level. If no tone is heard, the 2nd i-f amplifier is defective.

11. Move signal injection to the input of the 1st i-f amplifier. The speaker volume should again increase if the stage is operating normally.

12. Move signal injection to the input of the converter. If the tone is still aduible, the i-f section is ok. Continue testing in the rf section.

NOTE

A significant drop in volume as the injection is moved from the detector toward the converter should be checked as a possible source of trouble. It is possible that a defect has been detected, but due to 455-kHz signal radiation it is picked up at a subsequent point in the circuit after the defect with sufficient strength to provide an audible output. Keeping the signal level as low as possible for adequate testing helps reduce radiation and its related possible misinterpretation of test results.

13. With the rf cable still connected to the input of the converter, set the signal generator to any convenient broadcast band frequency (for example, 1000 kHz). Use a moderate signal level.

14. Tune the receiver to approximately the same frequency as selected in step 13. Search for the signal by tuning, as if tuning for a station. If no signal can be found, the local oscillator portion of the converter is defective. If the 400-Hz tone can be tuned in, the antenna circuit is defective.

OTHER USES FOR THE RF SIGNAL GENERATOR

ALIGNMENT

The rf signal generator may be used for alignment of receivers operating on short wave bands, marine bands, and most other frequency bands as well as the AM and FM broadcast bands. Refer to the manufacturer's instructions for alignment procedure.

MEASURING GAIN (Refer to Figure 8)

The voltage gain of an rf amplifier (or group of amplifiers) may be measured as follows:

1. Connect a VTVM or oscilloscope to measure the signal level at some convenient point in the output circuit.
2. Connect the rf signal to the output of the stage being tested.
3. Adjust the signal level for a convenient measurement level on the VTVM or oscilloscope. The signal level must be within the approximate range of normal operation for the stage. Let us assume, for an example, that the VTVM reads 1 volt. Using the carrier meter reading and the step ATTENUATOR settings, note the total attenuation in dB. Let us assume, for example, that the total attenuation is —54 dB.
4. Move the signal injection to the input of the amplifier.
5. Using the step ATTENUATOR's and FINE ATTENUATOR control, reduce the signal level until the VTVM or oscilloscope shows the same reading as in step 3. Again note the total attenuation. Let us assume for our example, that this total attenuation is —78 dB.
6. The gain of the stage (or group of stages) being tested is the difference between the total attenuation in step 5 and the total attenuation in step 3. In our example, the gain is 24 dB.

$$\begin{array}{r} 78\ \text{dB} \\ -54\ \text{dB} \\ \hline 24\ \text{dB gain} \end{array}$$

NOTE

This is a check of voltage gain, not power gain. Variations in impedance between the two injection points can substantially affect the reading in dB. Losses of non-gain circuits may be checked by the same method as gain.

USING THE RF SIGNAL GENERATOR TO LOCATE TROUBLES

The rf signal generator is an excellent instrument for locating defective circuits in equipment that can be tested with 400-Hz audio, and CW or amplitude modulated rf signals. Not only broadcast band AM and FM receivers, but short wave, marine band, amateur and two-way communications receivers plus almost any electronic equipment using tuned rf circuits can be tested. Audio, i-f and rf sections of receivers can be tested with this single instrument.

The "signal substitution" technique of troubleshooting is used to quickly locate the defective circuit. The "signal substitution" technique uses the output from the rf signal generator to substitute for the missing signal in the defective radio. The signal is usually injected at the speaker first, then moved one stage at a time toward the antenna until no output is obtained. The stage which produces no output is defective. All series components in the defective stage, such as coupling capacitors, transformers, etc. should be checked by the signal injection method to isolate the defect to as small an area as possible.

A typical example of the technique, using the rf signal generator to troubleshoot an AM receiver follows (also refer to Figure 7):

1. Connect test leads from the EXT MOD jacks of the signal generator to both sides of the speaker voice coil.

   CAUTION

   Use a dc blocking capacitor in series with the red probe to the high side of the speaker voice coil if there is any dc potential at this point. If the radio chassis is common to earth ground and the speaker voice coil is not common to the chassis, also use a dc blocking capacitor in series with the black probe.
2. Set the MODULATION switch to the 400 Hz OUT position.
3. Adjust the MOD LEVEL control for audible 400-Hz tone from the speaker. If the speaker is defective, no tone will be heard.
4. Move the test probes to the input of the audio output amplifier. Connect the black probe to chassis and use the red probe for signal injection. When testing push-pull amplifiers, inject the signal into each amplifier individually and listen for equal volume speaker output from each. If no tone is heard or unbalanced outputs are obtained, the stage is defective.

   Since amplification takes place in the stage, the tone heard in the speaker should be at higher volume than in step 3. Reduce the signal level as required with the MOD LEVEL control for a comfortable listening volume.
5. If the output in step 4 was normal, move the signal injection point to the input of the driver. The gain of the stage should provide a louder tone in the speaker. No tone means that the driver or the coupling to the output amplifier is defective.
6. Move the injection to the input side of the volume control. With the volume set to maximum, there will be less speaker output than in step 5 because an emitter follower has no gain. Check the volume control for smooth operation. No speaker tone indicates a defective component in the emitter follower stage.

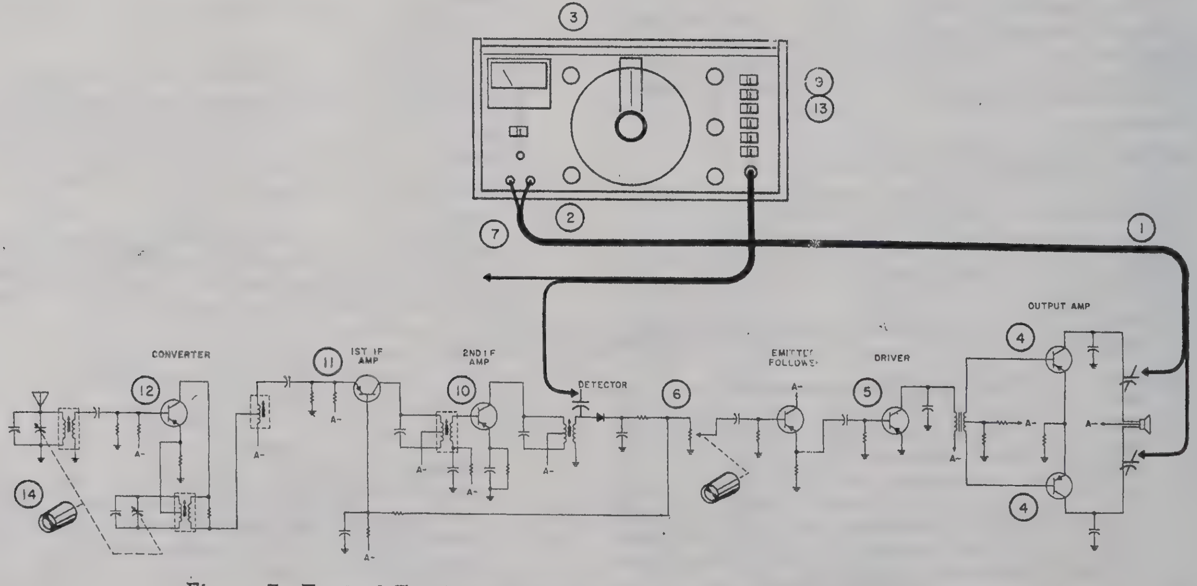


Figure 7. Typical Troubleshooting Technique Using RF Signal Generator

CIRCUIT DESCRIPTION

The following circuit description is made with reference to simplified block diagram Figure 10 and the schematic diagram. Oscillator stage Q-1 is operative for all ranges. The desired operating band is selected by range selector switch S2, and tuning is performed by tuning capacitor C-41. The output of oscillator Q-1 is coupled to buffer amplifier Q-2. This stage isolates the oscillator from the modulator and detector buffer stages. In addition, the emitter follower configuration of this stage provides a low output impedance which is applied across FINE ATTENUATOR control R-60. Two outputs are provided from buffer amplifier Q-2. The first is applied through FINE ATTENUATOR R-60 to the input of the modulator Q-3. The second output is coupled to detector buffer amplifier Q-4.

The modulator stage operates as a variable gain RF amplifier. The gain of this stage is varied by the application of audio voltage from the MOD LEVEL control R-79. With a fixed RF input determined by the setting of R-60, the instantaneous output is varied at an audio rate. Either internal or external audio modulation can be employed. Internal modulation is provided by the two-stage audio oscillator consisting of Q-9 and Q-10. The output frequency is approximately 400 Hz. The output of this oscillator is coupled to MODULATION selector switch S-3. The generator can be modulated externally by application of an audio voltage to the EXT MOD jack. This audio signal is also coupled to the MODULATION selector switch S-3. Either the internal or external modulation is supplied to MOD LEVEL adjustment R-79 by the MODULATION selector switch S-3. The amplitude of the audio signal is sampled by modulation detector D-8 which provides a d-c voltage proportional to the audio signal level. This is applied to METER switch S-4. When the METER switch is in the % MOD position, the modulation detector output is switched to meter amplifier Q-11 and from there to the carrier and modulation meter M-1. The meter is calibrated to indicate per cent modulation relative to the amplitude of the modulating voltage supplied. In the CW position of the MODULATION switch no audio voltage is applied to modulator Q-3.

MODULATION switch S-3 is designed to make available at the EXT MOD jacks the output of the internal audio oscillator when the switch is in the 400 HZ OUT position. This signal is useful in signal tracing audio circuits.

The RF output level of modulator Q-3 is sampled by RF detector D-3. The d-c output of the detector is supplied to METER switch S-4. When the METER switch is in the CARR position, the detector voltage is supplied to meter amplifier Q-11 and from there to the carrier and modulation meter M-1. The relative output level of modulator Q-3 is indicated on meter M-1 in decibels

The output of modulator Q-3 is coupled into the attenuator switching network consisting of switches S-5 through S-10. The output of the attenuator is supplied to RF OUT jack J-1. The RF cable provided with the generator has a built-in 50Ω termination. When this cable is connected to the RF OUT jack J-1, the generator is effectively terminated in 50Ω. Under these conditions (a 50Ω output termination) a 0 db indication on meter M-1 indicates an RF signal level of 100,000 μv at the output of modulator Q-3. The actual RF voltage level appearing at RF OUT jack J-1 is determined by the settings of ATTENUATOR switches S-5 through S-10 as described in the OPERATING section of this manual.

Internal reference oscillators are provided for calibration of the RF carrier frequency. Crystal controlled 1 MHz oscillator Q-5 and 100 KHz oscillator Q-6 are provided for this purpose. The XTAL CALIBRATOR switch S-2 selects either the 1 MHz oscillator output or the 100 KHz oscillator output and applies the selected signal to detector Q-7. The calibration signal is then heterodyned against the carrier signal supplied through detector buffer Q-4. When the difference frequency is within the audible frequency range, this is amplified by audio amplifier Q-8 and delivered to the speaker. The audio frequency decreases as the frequency of the generator approaches a harmonic of either the 1 MHz or the 100 KHz oscillator. When the frequencies are equal, a zero beat indication is obtained at the speaker.

CALIBRATION OF 100 KHz OSCILLATOR

The 100 Kilohertz calibration oscillator provided in the Model E-200D is of the L-C type and is extremely stable with respect to temperature and aging. If it is ever desired to check the accuracy of this oscillator, proceed as follows:

1. Remove the plug button provided on the bottom of the generator case. This makes the 100 KHz oscillator coil accessible for adjustment.
2. Set the RANGE SWITCH to Band A.
3. Set MODULATION SWITCH to CW position.
4. Set the TUNING DIAL to 10 on the A band (100 KHz). No output level adjustments are required.
5. Set the XTAL CALIBRATOR SWITCH to the 1 MHz position.
6. Slowly adjust the frequency dial until an exact zero beat is obtained at the speaker output.
7. Set the XTAL CALIBRATOR SWITCH to the 100 KHz position.
8. Adjust the 100 KHz oscillator coil through the access hole on the bottom of the unit very slowly to obtain an exact zero beat indication at the speaker output.
9. Reset the XTAL CALIBRATOR SWITCH to the 1 MHz position and verify that the unit is at the exact zero beat position. The 100 KHz oscillator is now calibrated against the internal 1 MHz crystal oscillator.
10. Replace the plug button in the access hole on the bottom of the generator case.

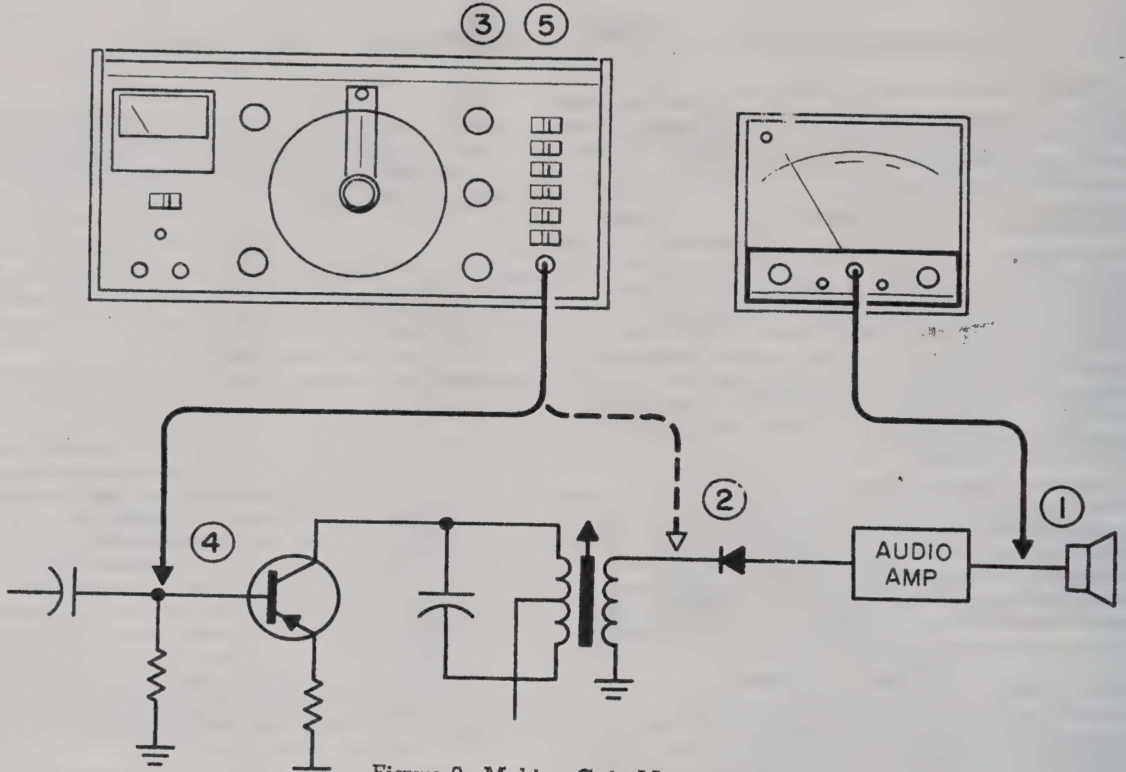
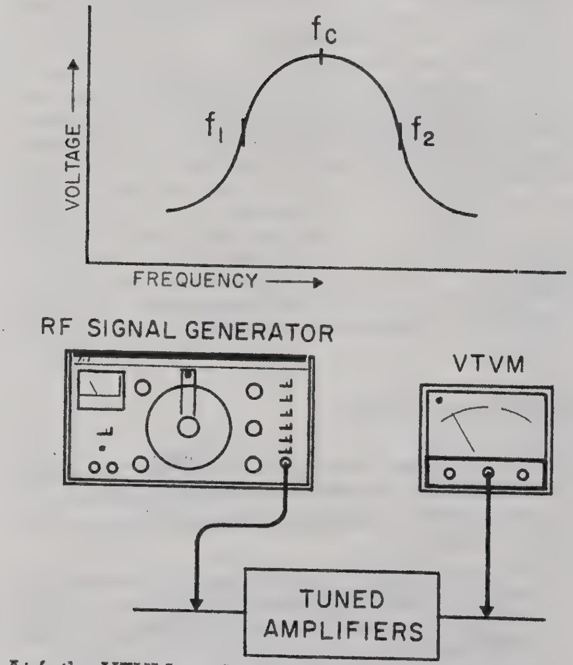


Figure 8. Making Gain Measurements



At f_c the VTVM reads maximum.

At f_1 and f_2 the VTVM reads $\frac{\text{max}}{2}$ (—6 dB)

Bandwidth = $f_2 - f_1$

Figure 9. Measuring Bandwidth

MEASURING BANDWIDTH (refer to Figure 9)

The bandwidth of a stage or group of stages (such as an entire i-f section) may be measured as follows:

1. Connect a VTVM or oscilloscope to measure the output level of the circuit being measured.
2. Inject rf signal at the input of the circuit being measured.
3. Tune the frequency of the signal generator for maximum output on the VTVM or oscilloscope (f_c).
4. Decrease the frequency of the signal generator until the VTVM or oscilloscope reads one half the value in step 3. Note the frequency (f_1).
5. Increase the signal generator frequency past the maximum VTVM reading until the VTVM reads the same as in step 4. Again note the frequency (f_2).
6. The difference between f_1 and f_2 is the bandwidth.

NOTE

This procedure uses the standard —6 dB voltage points (one half maximum voltage) for measurement of bandwidth. Other criteria may be substituted if desired.

Another method of measuring bandwidth is to use a sweep generator as the signal source, the rf signal generator as a marker generator, and display the results on an oscilloscope. This method presents a visual display similar to the response curve shown in figure 9.

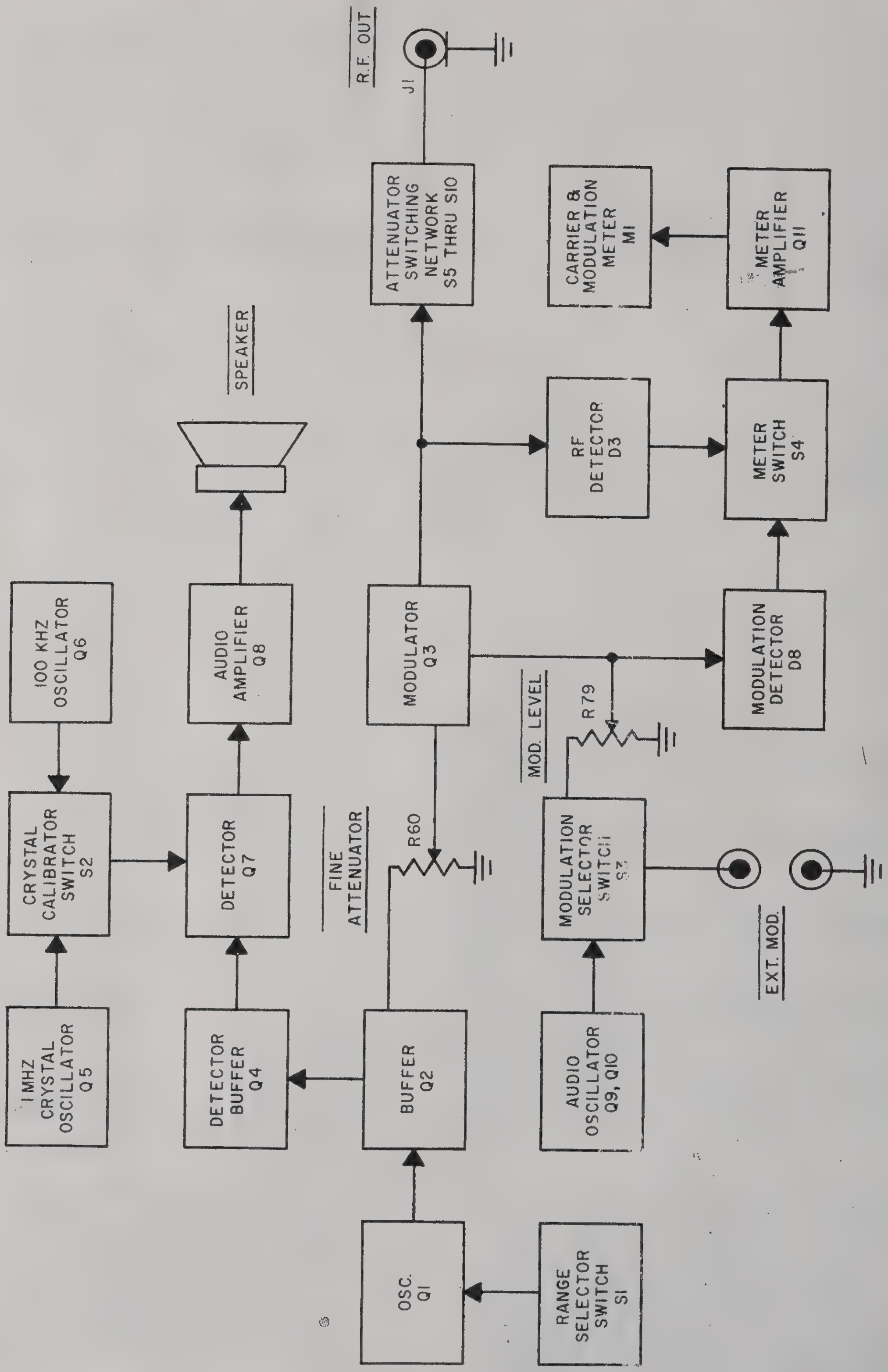


Figure 10. Model E200D Block Diagram

B+K PRECISION DYNASCAN CORPORATION

6460 West Cortland Street
Chicago, Illinois 60635

INSTRUCTION MANUAL

B+K PRECISION 52

520B

TRANSISTOR TESTER

B+K PRECISION DYNASCA
CORPORATI

TEST INSTRUMENT SAFETY

WARNING

An electrical shock causing 10 milliamps of current to pass through the heart will stop most human heartbeats. Higher voltages pose an even greater threat because such voltages can more easily produce a lethal current. However, voltage as low as 35 volts DC or AC RMS should be considered dangerous and hazardous since it can produce a lethal current under certain conditions. Your normal work habits should include all accepted practices that will prevent contact with exposed high voltage, and that will steer current away from your heart in case of accidental contact with a high voltage. Be alert to the following hazards when using the Model 520B Transistor Tester:

1. When performing in-circuit testing of semiconductors, make sure power is removed from the circuit under test. For "hot chassis" equipment, disconnect the power plug in addition to turning off the on-off switch. Most recent television sets, audio equipment, and other equipment with a 2-wire power cord are transformerless "hot chassis' powered, where one side of the ac power line connects directly to the chassis. If such equipment does not have a polarized power plug to prevent insertion the "wrong" way, a serious shock hazard exists if the chassis is touched. Additionally, damage to the semiconductor tester or the equipment under test could result. Unplug any such equipment from its ac outlet; just turning off the on-off switch does not eliminate the hazard. To be on the safe side, treat all equipment as "hot chassis" unless you are sure it has an isolated chassis or an earth ground chassis.

2. Servicing of the transistor tester should be performed only by qualified electronics technicians who are trained to work safely in the presence of high voltage. Line voltage (120 or 240 VAC) may be present at points in the primary power circuit any time it is connected to an ac outlet, even if the unit is turned off. Always observe caution when the covers are removed from the tester.

INSTRUCTION MANUAL

for

Model 520B

TRANSISTOR TESTER

B&K PRECISION

DYNASCAN CORPORATION
6460 W. Cortland Street
Chicago, Illinois 60635

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INTRODUCTION

The B & K-Precision Model 520B Transistor Tester is designed for in-circ and out-of-circuit transistor testing, with special features for making additional te on devices out-of-circuit.

It uses both a high-current, low duty-cycle pulse technique to test transistors the presence of shunting circuitry, and a low-current drive system which enables t user to identify the terminals of the device in most in-circuit tests and out-of-circuit checks.

The instrument is designed for a minimum amount of control manipulati making for rapid testing of most devices.

SPECIAL FEATURES

1. Patented limited-energy pulse circuit permits highly successful use of in-circ testing in the presence of low shunt impedances with complete safety for t device under test.
2. A human-engineered panel design which eliminates the need for reference the operating manual – only three switches, no panel adjustments.
3. Six-position TEST switch sequentially connects the device being tested in possible configurations, making it unnecessary to know the device termi identification. Can be left in GOOD position so that additional tests can made without memorizing test position.
4. Base or gate lead identified by color as TEST switch is operated when testi with HI drive. All leads of transistor are identified when testing with LO dri
5. Audible tone tells when the device under test is good – no need to take ey off circuit board while testing hard-to-get-at devices.
6. A logarithmic leakage meter which displays a wide leakage current range on single meter scale.
7. Automatic polarity indication to identify NPN or PNP type devices.
8. Identification of SILICON and GERMANIUM device types for prop evaluation of leakage current with color-keyed LED indicators for positive te interpretation.
9. Clip-on test leads that make positive connections to devices in difficu locations. Free operator's hands to make further tests.
10. Choice of test leads or front panel socket for out-of-circuit tests.

SPECIFICATIONS

IN-CIRCUIT:
GOOD/BAD test for transistors, FET's, or SCR's.
Identifies transistor as NPN or PNP and FET as N or P channel.
Identifies SILICON or GERMANIUM transistors.
Identifies gate lead of FET or base lead of transistor (HI drive).
Identifies all leads of transistor when using LO drive.
Identifies all leads of SCR's.

OUT-OF-CIRCUIT:
GOOD/BAD test for transistors, FET's or SCR's.
Identifies transistor as NPN or PNP and FET as N or P channel.
Identifies SILICON or GERMANIUM transistors.
Identifies gate lead of FET by test lead color.
Identifies all leads of transistor or SCR by test lead color.
Measures reverse LEAKAGE from 0.1 μA to 5 mA.
Measures I_{DSS} and gate leakage of FET's.

APPLIED TEST CURRENTS:
Base Drive: 250 mA (HI drive) or 1 mA (LO drive) at 4% duty cycle.
Collector Drive: 125 mA at 4% duty cycle.
Test Repetition Rate: 10 per second.
Reverse Voltage for leakage test: 2.OV.

LIMITING IN-CIRCUIT SHUNT VALUES FOR VALID GOOD/BAD TEST:
Resistance: Down to 10 ohms with HI drive.
Down to 1.5K ohms with LO drive

Capacitance: Up to 15 mfd with HI drive.
Up to .3 mfd with LO drive.

ACCESSORIES:
Three test leads with mini-lock clips supplied.
FP-5 Dynaflex Probe (optional).

SIZE: 8" x 7" x 3½"

WEIGHT: 5 lbs.

POWER REQUIREMENTS: 120 VAC. 60 Hz. 5 watts.

BRIEF SUMMARY OF WHAT THE 520B WILL DO

1. Determines good or bad transistors, FET's or SCR's, in or out-of-circuit.
2. Determines good or bad diodes in or out-of-circuit.
3. Identifies Emitter-Base-Collector leads of transistors.
4. Identifies gate lead of FET's.
5. Indicates polarity of good devices (NPN or PNP; N or P Channel).
6. Identifies Cathode-Gate-Anode leads of SCR's.
7. Indicates whether SILICON or GERMANIUM.
8. Measures I_{CES} or I_{BES} of transistors.
9. Measures I_{DSS} and gate leakage of FET's.
10. Measures reverse leakage current of diodes.
11. Determines whether device is transistor, FET or SCR.

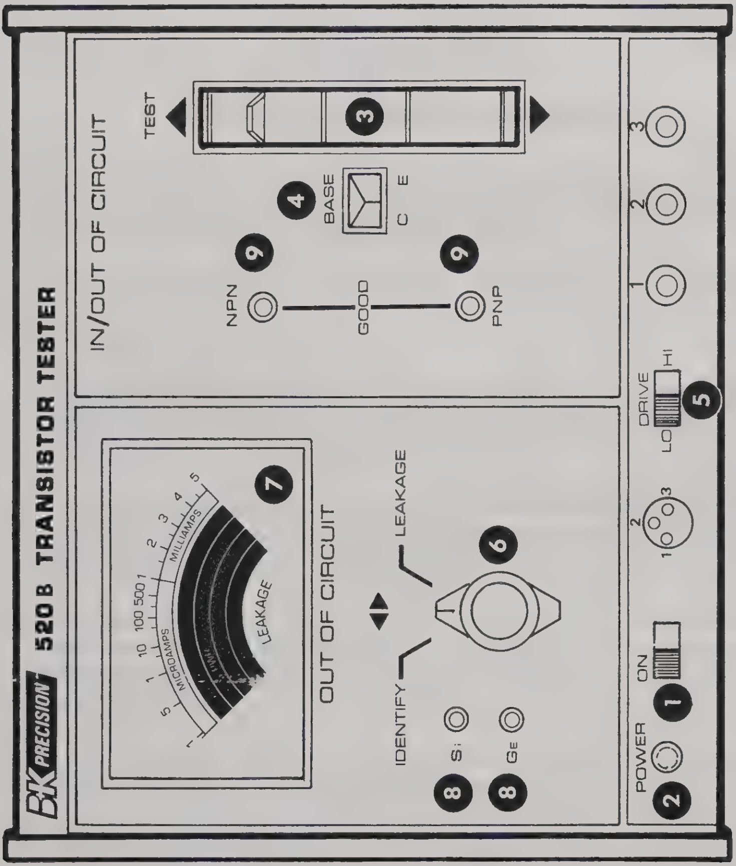


Fig. 1. Front panel showing controls and indicators.

CONTROLS AND INDICATORS

1 **POWER ON Switch:**	Applies power to 520B
2. **POWER ON Lamp:**	Indicates power is ON.
3. **TEST Switch:**	Selects proper device connection for testing and lead identification.
4. **Lead Identification Window:**	Identifies leads by color.
5. **DRIVE Switch:**	Selects LO or HI base drive.
6. **FUNCTION Switch:**	Spring-return switch selects either of two additional tests: a. I_{CES} or I_{BES} for transistors; I_{DDS} and gate leakage for FET's. b. Identifies device material (silicon or germanium).
7. **LEAKAGE Meter:**	Indicates device leakage current. a. Indicates safe leakage limits for typical silicon and germanium transistors. b. Indicates I_{DSS} and gate leakage for FET's.
8. **IDENTIFY Lamps:**	Indicate silicon or germanium device.
9. **NPN and PNP Lamps:**	Indicate polarity of good devices.
10. **AUDIBLE TONE:**	Indicates good device.

HINTS AND KINKS

IDENTIFYING TRANSISTORS AND DIODES

1. Nearly all germanium transistors come in metal cases, either the tubular type with flexible leads, or in the standard TO-5 package.
2. Power transistors in stud packages or in the TO-5 or TO-3 can be either germanium or silicon, depending on age. Two and three digit 2N-numbers are mostly germanium.
3. The TO-66 power transistors and the plastic power tab packages are nearly always silicon. The collector is usually, but not always, connected to the mounting tab and the center lead.
4. The base lead of most modern plastic type transistors is either the center lead or the right hand lead when facing the flat side with the leads down. In the latter case the collector lead is in the middle.
5. Most plastic FET's have the gate lead on the right side when facing the flat side with the leads down, and the source in the middle, but there are exceptions. With nearly all junction FET's, the source and drain can be interchanged with no adverse effects.
6. All transistors will have some gain with the collector and emitter leads interchanged, with the exception of Darlingtons.
7. Germanium signal diodes can usually be recognized by their transparent hollow glass cases with either three or four color bands, or type numbers printed on them. Silicon diodes are usually painted because silicon is light-sensitive and must be protected from ambient light. The "moose" types, such as the stud package, can be either germanium or silicon.

THINGS TO KNOW ABOUT THE 520B

1. There are certain semiconductor devices that look like transistors which th 520B cannot test. These include: Triacs, diacs and diode arrays.
2. In HI drive, most transistors that test good will do so in *two* adjacent TES switch positions. This is because transistors have some gain when the collecto and emitter are interchanged. If the circuit is heavily shunted, or the "revers beta" of the transistor is very low, the transistor will test good in only *on* TEST switch position. In either case, the transistor can be considered good.
3. In LO drive, most transistors that test good will do so in only *one* TEST switc position. In some rare cases, high-frequency transistors or transistors wit higher than usual "reverse beta" may test good in *two* adjacent TEST switc positions having the same BASE color in the Lead Identification Window. Thi is still a valid good test, but only the base lead of the transistor can b identified.
4. FET's can be tested in either LO or HI drive, but only FET's with a high G_m will test good in LO drive. Therefore, to insure a valid good/bad test for al junction FET's, the DRIVE switch should be set to HI when the device bein tested is known to be an FET. The 520B detection circuit is more sensitive i the HI drive position.

USING THE MODEL 520B

IN-CIRCUIT TESTING

CAUTION: Make sure all power is turned off in the circuit being tested, and that all capacitors are discharged.

A. Transistors/FET's

1. Set the DRIVE switch to the LO position.
2. Connect the three test leads in any manner to the three leads of the device you wish to test.
3. Move the TEST switch slowly through its six positions or until the tone is heard. One of the two red lamps will glow indicating whether the device is NPN or PNP, or N or P channel (the NPN lamp will glow if the FET is N Channel and the PNP lamp will glow if the FET is P Channel). In LO drive, most transistors that test good will do so in only *one* TEST switch position (see THINGS TO KNOW ABOUT THE 520B). In this TEST switch position, all the leads of the transistor can be identified as shown in the Lead Identification Window. Most FET's will test good (LO or HI drive) in *two* adjacent TEST switch positions having the same BASE color shown in the Lead Identification Window, since practically all junction FET's are symmetrical. The BASE color indicated is the *gate* lead of the FET.
4. If no tone is heard as the TEST switch is slowly moved through its six positions, in LO drive, then the device under test is one of the following:
    a. Transistor with high leakage or very low gain (may not function properly in circuit).
    b. Device with open/shorted elements.
    c. Device with excessive circuit shunting (see SPECIFICATIONS).
    d. FET that will not test with LO drive.
5. Retest the device using HI drive. In HI drive, most transistors that test good will do so in *two* adjacent TEST switch positions having the same BASE color shown in the Lead Identification Window. Only the base lead of the transistor can be identified.
6. If the device tests good using HI drive, then 4 (a) above could be true.
7. If the device does not test good in any TEST switch position, in HI driv remove the device from the circuit and retest using OUT-OF-CIRCUI procedures.

B. SCR's

1. Set the DRIVE switch to the HI position.
2. Connect the three test leads in any manner to the three leads of the SC you wish to test.
3. Move the TEST switch slowly through its six positions or until the NP lamp glows in one position and the PNP lamp glows in another positio having a different BASE color as shown in the Lead Identificatio Window.
4. The SCR is good *only* if all the following are obtained:
    a. One NPN indication.
    b. One PNP indication.
    c. Indications must not have same BASE color.

    LEAD IDENTIFICATION:

    a. The BASE color shown in the Lead Identification Window is the *gat* lead when the NPN lamp glows.
    b. The BASE color shown in the Lead Identification Window is th *cathode* lead when the PNP lamp glows.
5. If the SCR tests bad, then it should be removed from the circuit and teste again (may be subject to excessive shunting in-circuit).

C. Diodes

Connect the blue and yellow test leads across the diode. Test for LEAKAGE i uppermost and second positions (GREEN BASE) of TEST switch. One position wil read full scale, while the other will give a lower reading depending on the shuntin effect of the circuitry. If both positions produce full scale readings, the diode i either shorted or heavily shunted by low resistance circuitry; for example, transient suppressor diode across a relay or solenoid coil. In this case the diod should be disconnected from the circuit and retested.

D. “Hands Off” Testing

When the base lead of devices being tested can be identified, leave the test switch in the uppermost position. The transistors can then be probed one by one by connecting the green lead to the base, and the blue and yellow leads to the collector and emitter respectively. The audible tone will tell you when the transistor is good. Occasionally, the collector and emitter leads may have to be interchanged to produce a tone.

The “Hands Off” method is useful when it is necessary to test a number of transistors in a circuit, or when it is impossible to connect all three leads to the device being tested: If one lead can be clipped on the device, both hands are free to probe the remaining two leads. With this feature, you can also use the B & K-Precision DYNAFLEX MODEL FP-5 PROBE (optional) to test devices from either side of the P.C. board.

E. Intermittent Testing

Often the Model 520B can be used to identify intermittent transistors in a circuit. Connect the test leads to the suspected transistors and move the TEST switch until the tone is heard. Then, leaving the 520B in this position, the transistor can be subjected to various physical tests such as tapping, heating, or cooling. An intermittent transistor will show up as an intermittent tone.

HINT: A can of “Instant Cold Spray” is quite useful for providing rapid cooling of discrete components.

OUT-OF-CIRCUIT TESTING

A. Transistors

1. Set the DRIVE switch to the LO position.
2. Connect the three test leads to the device or plug it into the convenient test socket on the Model 520B panel (no need to worry about lead identification).
3. Slowly move the TEST switch until the 520B indicates a good transistor and produces an audible tone. Leave the TEST switch in this position and identify all the leads of the transistor by the colors shown in the Lead Identification Window. In LO drive, the transistor should test good in only *one* TEST switch position (see “THINGS TO KNOW ABOUT THE 520B”).
4. If no tone is heard as the TEST switch is slowly moved through its si positions, in LO drive, then the device under test is one of the following
    a. Transistor with high leakage or very low gain (may not functio properly in-circuit).
    b. Transistor with open/shorted elements.
    c. Device is an FET. If this can be verified from available servic information, retest as outlined below.
    d. Device is a power Darlington which requires high base voltage. If thi can be verified from service information available, retest using H drive.
5. A transistor which tests *good* can be further evaluated for leakage an material identification.
6. LEAKAGE TESTS. Set DRIVE switch to HI. Move the TEST switch to position which produces a good indication and turn the function switch t LEAKAGE and note the meter indication. Hold the function switch i LEAKAGE position and move the TEST switch to the other positio which displays the same BASE color in the Lead Identification Window The leakage should be about equal in both TEST positions, and within th limits shown on the meter scale, In one of the positions the mete indicates I_{CES}; in the other I_{BES}.
7. IDENTIFICATION OF TRANSISTOR TYPES: If the type of transistor is not known, turn the function switch to IDENTIFY position and the Model 520B will indicate whether the device is SILICON (yellow LED glows) or GERMANIUM (green LED glows). The leakage indicated can then be compared to the proper limits marked on the meter face. The meter leakage scales are color-keyed to the LED IDENTIFY indicators.

B. FET’s

1. Set the DRIVE switch to the HI position.
2. Slowly move the TEST switch until the 520B indicates a good FET.
3. J-FET’s will indicate good in *two* adjacent TEST switch positions which have the same BASE color. (Most J-FET’s are symmetrical.)
4. The BASE color shown in the Lead Identification Window is the *gate.*
5. If no audible tone is heard then the FET under test is defective.

6. A FET which tests *good* can be further evaluated as indicated in the following steps.

7. I_{DSS} LEAKAGE. Move the TEST switch to a position which produces a good indication, then turn the function switch to LEAKAGE. The meter will read I_{DSS}. Note that the I_{DSS} of FET's can range from a few microamperes to several milliamperes, and in some cases will read off scale on the 502B.

8. FET GATE LEAKAGE. Drain-to-gate or source-to-gate leakage of either N-Channel or P-Channel FET's can be tested by treating the gate junction as a diode. First, locate the gate lead by moving the TEST switch through each of its six positions until the tone is heard. The *gate* lead is the BASE color which appears in the Lead Identification Window. Then connect the FET gate to the blue test clip and one or both of the remaining FET leads to the yellow test clip. Move the TEST switch through the uppermost and second positions (GREEN BASE) and check for leakage. The leakage should be zero in one of the positions if the device is a J-FET, or both positions if it is a MOS-FET.

9. N-Channel FET drain or source-to-gate leakage can be measured in another way. Leave the FET connected to the three test leads. Put the TEST switch in any position which does not indicate good. Then, holding the FUNCTION switch in the LEAKAGE position, move the TEST switch through all six positions and watch the meter. If the device is good, the meter will indicate zero current in two of the six positions. P-Channel FET's must be measured as diodes, as described above.

10. DEPLETION MODE FET'S. Drain-to-source leakage of depletion mode FET's cannot be measured reliably by the Model 520B, as this requires that the gate be reverse-biased while testing. Merely disconnecting the gate lead leaves the device subject to stray pickup and/or leakage currents, and with the extremely high gate impedance there is no way of assuring that the gate will pinch off.

11. ENHANCEMENT MODE FET's. Enhancement mode FET's can be tested in the same way as transistors.

Diodes

1. LEAKAGE. Connect the blue and yellow test leads to the two ends of the diode. Hold the function switch in the LEAKAGE position while moving the TEST switch through the two green BASE positions. If the diode is good the meter will indicate full scale in one position and will indicate zero or some low value in the other. The low reading is the LEAKAGE current of the diode.

2. LEAD IDENTIFICATION. The anode and cathode leads of the diode ca be identified. Connect the blue and yellow test leads to the diode lead While holding the function switch in the LEAKAGE position, move th TEST switch to whichever of the two green BASE positions produces full scale reading. The diode *cathode* is connected to the test lead colo indicated as the COLLECTOR in the Lead Identification Window.

D. SCR's

1. Set the DRIVE switch to the HI position.

2. SCR's will indicate NPN in one TEST switch position and PNP in anoth position that does not have the same BASE color as shown in the Lea Identification Window.

3. The SCR is good *only* if all the following are obtained:

   a. One NPN indication.

   b. One PNP indication.

   c. Indications must not have same BASE color.

   LEAD IDENTIFICATION:

   a. BASE color is *gate* lead when the NPN lamp glows.

   b. BASE color is *cathode* lead when the PNP lamp glows.

HOW THE 520B WORKS

TEST SWITCH

1. The 520B transistor tester uses a six-position lever switch located at the right side of the panel to connect the device being tested in the correct manner for testing. As this switch is moved from top to bottom, the device connected to the three test leads, or plugged into the socket, is connected in all possible configurations to the testing circuit. The uppermost position is the "normal" connection, in that the socket is connected in standard triangle configuration to the testing circuits and the blue, green and yellow leads are connected to the collector, base and emitter circuits respectively.

2. In two of the six positions, using HI drive, the device is connected properly for testing. This is true since almost all transistors have gain, although usually very little, when the collector and emitter are interchanged, and most junction FET's are symmetrical. These two positions are always adjacent, and always display the same base color in the Lead Identification Window whenever the 520B is indicating a good device.

3. In LO drive, a transistor should indicate good in only one switch position since limited base drive allows the detector to test the transistor as a good device in only its high gain connection.

GAIN TEST CIRCUIT

4. The 520B circuitry generates a continuous series of pulses specially designed to periodically test a transistor about ten times per second. These short, high-current pulses apply a voltage pulse to the collector, first positive for testing NPN devices, followed by negative for testing PNP (see Fig. 2a). During this pulse, a shorter pulse of the same polarity is applied to the base of the device which drives the collector voltage toward saturation. Taking a closer look at the basic pulse circuitry, refer to Fig. 2. T1 is the period clock, which runs at approximately 10 Hz. It initiates each test period while simultaneously resetting FFl and FF2. T2 runs at 1000 Hz and controls the pulse-forming circuits.

5. The pulse-forming circuit uses a combination of toggles and RS flip-flops to produce the proper sequence of pulses for the collector drive circuit A and the base drive circuit B. A and B are level-shifting complementary drivers which can deliver several hundred milliamperes at +5V and −5V or return to zero volts.

6. A properly connected NPN transistor, as shown above, will see the waveform at Fig. 2A, and its base will see the waveform at Fig. 2B. Note that during the

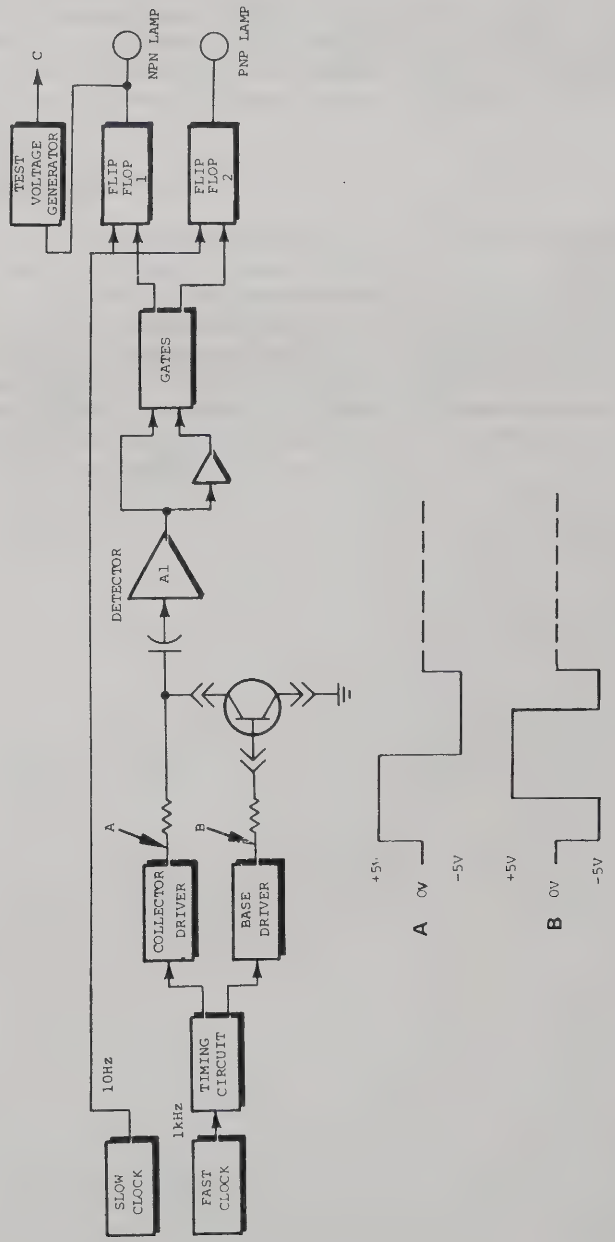


Fig. 2. Block diagram.

positive excursion of the collector voltage, the base is driven first negative and then positive. If the transistor being tested is NPN, the collector voltage will drop abruptly when its base is driven positive. This negative-going transition, which can only occur if transistor action is present, is differentiated and the differentiated signal is used to latch flip-flop 1.

If a PNP transistor is tested, the turn-on transition occurs in the second half of the waveform 2A, and in the opposite direction.

The PNP output pulse is inverted in order to have the proper polarity to operate flip-flop 2. Of course, other pulses appear at the differentiator output, since all voltage transitions are similarly differentiated, but the synchronized gating circuits prevent the unwanted pulses from reaching the lamp driving flip-flops and thus eliminating wrong indications.

The input to FF1 is only enabled during the time period in which an NPN device can be detected and similarly, FF2 is only enabled when a PNP device can be detected. Only the flip-flop which corresponds to the type of device being tested can be latched, lighting the lamp corresponding to that device.

In addition to being connected to the LED's on the panel, both outputs are connected through an OR gate to activate the audible tone if either of the latches operate. Thus, if the basing and polarity of a device is unknown, the TEST switch can be moved from position to position until the tone is heard.

It is then left in that position and the polarity of the device is indicated by one of the PNP-NPN lamps on the 520B panel. If the switch is left in this position, the circuitry is then set up to make several additional out-of-circuit tests on the transistor.

The output of FF1 is either +5V or 0, depending on whether the device tested was PNP or NPN. This output in turn drives another level-shifting complementary circuit which produces either +5V or −5V, but always at the correct polarity to further test the same device. When not testing, this voltage is always left at −5, to be available for diode testing.

URRENT METER

. The 520 is equipped with a special non-linear meter circuit to measure I_{CES} and I_{BES}. When the FUNCTION switch is turned to LEAKAGE, two things happen. First, the reset pulse is inhibited from FF1 and FF2. This leaves FF1 in the state in which it was while "Gain Testing" the transistor. FF1 in turn, through the test generator, produces the correct output voltage for testing at point (C), + for NPN or − for PNP.

Second, the switch connects the collector to this supply, and and the base an emitter to the current meter circuit. The meter circuit is designed fc essentially zero voltage drop at its terminals so that the device is always teste at the proper voltage, and is made non-linear to measure a very wide range c currents on a single scale.

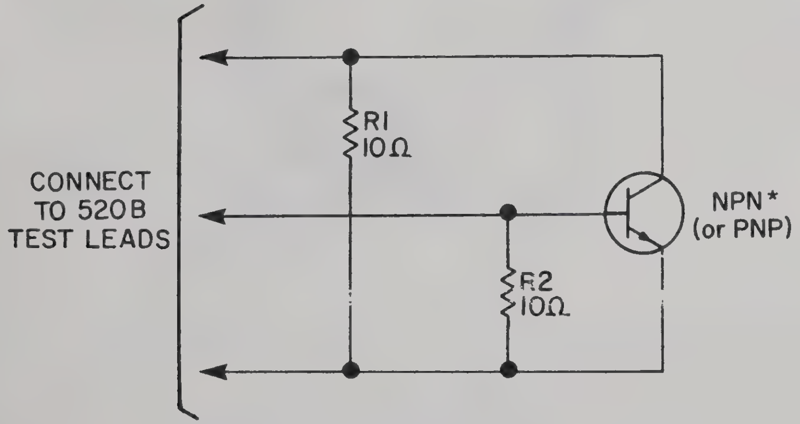
IDENTIFICATION CIRCUIT

8. When switching to IDENTIFY, the flip-flop reset circuit is inhibited as befor to lock the test voltage in the proper polarity. The base-emitter junction is the current-fed, and connected to a special voltage comparator which produces +5 output for a Base-to-Emitter voltage above approximately ±.5V, or zer output for B-E voltage less than ±.5V. The output drives one of two LED's depending on its state, indicating either silicon, which always produces mor than .5V drop, or germanium, which seldom produces more than .4V drop The LED's are enabled only when a good test is performed, and only when th switch is in the IDENTIFY position.

OPERATIONAL TESTS

1. To ensure that the 520B is operating according to specifications, test for proper output drive power. This can be done easily by building the simple circuit in Fig. 3. The 520B must be switched to the HI drive position. Transistor should check good in only *one* TEST switch position.

2. To test the LO drive function of the 520B, eliminate R1 and replace R2 with a 1.5kΩ resistor in Fig. 3. The transistor should check good in only *one* TEST switch position.



*GENERAL PURPOSE TRANSISTOR WITH A BETA OF 100 OR GREATER.

Fig. 3.

CALIBRATION AND SERVICE

1. **Meter Calibration.** The only part of the 520B which may require calibration is the leakage current meter. The following procedure should be followed:

   a. Turn off the 520B. If the meter does not indicate zero, insert a screwdriver in the hole on the front panel just below the meter and adjust it to indicate zero.

   b. Remove the back of the instrument by removing the five screws at the bottom and rear of the case. Locate TP1 near the top center of the P.C. board. Connect TP1 to the metal chassis with a jumper. Turn on the 520B. If the meter is not indicating zero, adjust the ZERO control with a screwdriver through the left side hole in the top of the chassis until the meter balances. The zero control is identified on the P.C. board just below the adjustment hole (see Fig. 4). Remove the jumper.

   c. To calibrate the meter, put the TEST switch in the uppermost (green) position. Connect a 2000Ω potentiometer and a 0-5mA meter in series from the yellow jack to the blue jack as in Fig. 4. Then while holding the FUNCTION switch in the LEAKAGE position, adjust the potentiometer for 5 milliamperes in the external meter. If the meter on the 520B panel does not read full scale, adjust the "CAL" control through the right side hole in the top of the chassis. The CAL pot is identified on the P.C. board just below the adjustment hole. See Fig. 4.

2. **520B Power Supply Voltages.** Can be measured at the points marked +5 and −5 and GND on the lower right hand corner of the P.C. board. they must be between 4.7 and 5.3V. for proper operation.

3. **Observation of Waveforms.** The waveform applied to the collector and base of the device under test can be observed with an oscilloscope connected to the jacks on the 520B panel. Leave the TEST switch in the uppermost position as above, and place a 1kΩ to 10kΩ resistor between the yellow jack and the green jack. Connect the scope ground to the yellow jack (emitter) and the vertical input to the green jack (base). The base waveform should be as shown in Fig. 2b. Connect the resistor between yellow and blue jacks. Connecting the vertical input to the collector jack (blue) should produce the waveform shown in Fig. 2a. A dual trace oscilloscope is especially convenient for observing both waveforms simultaneously.

If the line fuse blows, it must be replaced with a 1/16A, 3AG Slow-Blow fuse. Remove the back cover, as in "CALIBRATION". Remove the right end panel of the case (the side nearest the "TEST" switch). The fuse is found on the P.C. board near the power transformer. It is unlikely that the fuse will blow without some accompanying circuit failure. Look for shorted rectifier diodes (D1-D4) or input filter capacitors (C1 and C2).

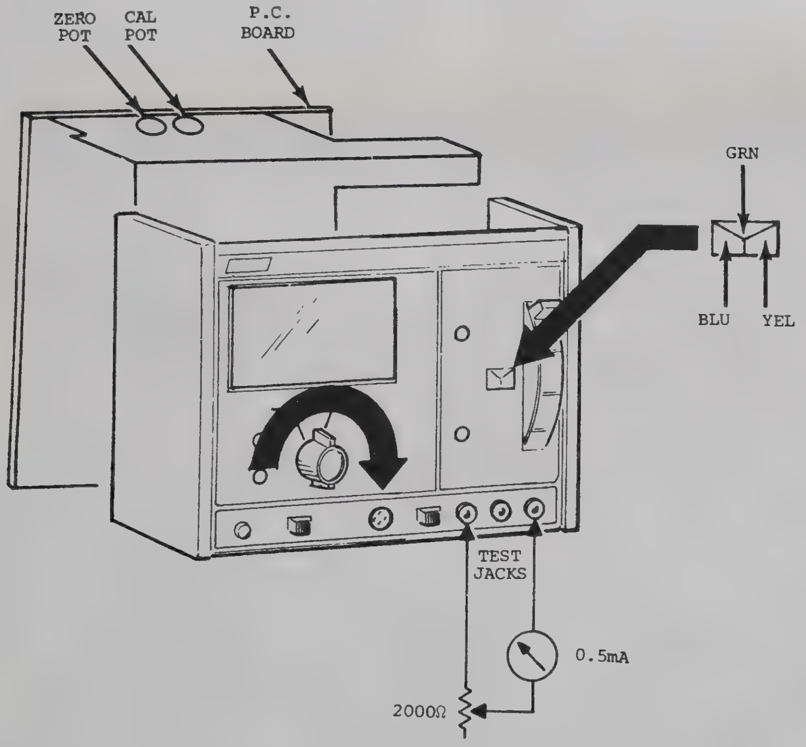


Fig. 4. Location of calibrating controls.

WARRANTY SERVICE INSTRUCTIONS

1. Refer to the MAINTENANCE section of your B & K-Precision instruction manual for adjustments that may be applicable.
2. Defective parts removed from units which are within the One Year Limited Warranty period should be sent PREPAID to the Service Department listed below. Be sure to state the model and serial number of the unit from which the parts were removed and date the unit was purchased. These parts will be exchanged at no charge, under the terms of the Warranty.
3. If the above-mentioned procedures do not correct the problem you are experiencing with your unit, pack it securely (preferably in the original carton or double-packed). Enclose a letter describing the problem and include your name and address. Deliver to, or ship PREPAID (UPS preferred) to the nearest B & K-Precision authorized service agency (see list enclosed with unit).

If your list of authorized B & K-Precision service agencies has been misplaced, contact your local distributor for the name of your nearest service agency, or write to:

Service Department

B & K-Precision Product Group
DYNASCAN CORPORATION
2815 West Irving Park Road
Chicago, Illinois 60618

INSTRUCTION
MANUAL

B&K Model 466

CATHODE RAY TUBE TESTER/REJUVENATOR

B&K

Product of DYNASCAN CORPORATION
1801 West Belle Plaine Avenue, Chicago, Illinois 60613

INSTRUCTION MANUAL

FOR

Model 466

CATHODE RAY TUBE TESTER/REJUVENATOR

B & K DIVISION OF DYNASCAN CORPORATION
1801 West Belle Plaine Avenue
Chicago, Illinois 60613

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BRIEF SUMMARY OF
WHAT THE MODEL 466 WILL DO

1. The Model 466 CRT Tester/Rejuvenator will rapidly test a cathode ray tube (using CRT manufacturers' accepted techniques and safeguards) for all the important factors which determine the quality of a tube. The Model 466 will check for shorts or leakage between the elements in the tube and will also indicate between which elements the fault exists.
2. The 466 will check the amount of emission from the cathode (s) and will directly and rapidly indicate relative emission balance between the guns of a color cathode ray tube.
3. The 466 will check the warmup characteristics of a tube.
4. It will repair most common faults in cathode ray tubes, such as shorts between elements, open connections to elements, and inter-element leakage.
5. It will rejuvenate picture tubes having low emission. Other capabilities of the Model 466 are described in the next section.

WHY YOUR NEW MODEL 466 IS THE MOST ADVANCED TESTER OF ITS TYPE

The Model 466 CRT Tester/Rejuvenator has been designed by B&K to accurately evaluate virtually any television cathode ray tube.

This professional quality CRT tester retains the proven, valuable capabilities of its predecessors and also incorporates new important advances. These advances include:

1. A human-engineered control panel which organizes and streamlines the test by guiding the user rapidly through the correct test sequence.
2. Advances in internal circuitry which provide more directly useful features and greater test precision than any comparable tester.
3. A large precision meter which is numerically coded to the front-panel controls to minimize setup time and permit highly accurate, error-free evaluation of the CRT under test.
4. Color-coded: leakage and emission scales.
5. G_1 voltage and heater voltage (right at the tube pins) are precisely monitored on meter.
6. Continuously variable heater voltage, which can be precisely set on meter, effectively protects the instrument from obsolescence by the appearance of future CRTs having new heater voltages.
7. The voltages to grid 1 and grid 2 are continuously variable permitting the tube to be checked under conditions similar to operation of the tube within the receiver.
8. Improved power supply transformer provides greater safety and up-to-date comprehensive coverage of all new filament voltages.
9. New color tracking normalize feature which greatly simplifies color tube evaluation and reduces time for determining proper color gun tracking.
10. New simplified warmup test for color CRTs.
11. Direct metering of relative cathode emission improvement when using any of the Rejuvenate features. This eliminates need to repetitiously

recycle previous test steps, saves time and permits immediately detecting the extent to which rejuvenation should be performed.

12. Simplified life test.

13. Activate mode provides precise metered monitoring of activation.

14. Rejuvenation capability is provided in three improved steps, the first two of which are automatically timed to prevent damage to a tube. The unique Super Rejuvenate feature provides even greater capability for restoring the emission of an aging and otherwise worthless CRT.

15. The largest storage space of any CRT tester currently available.

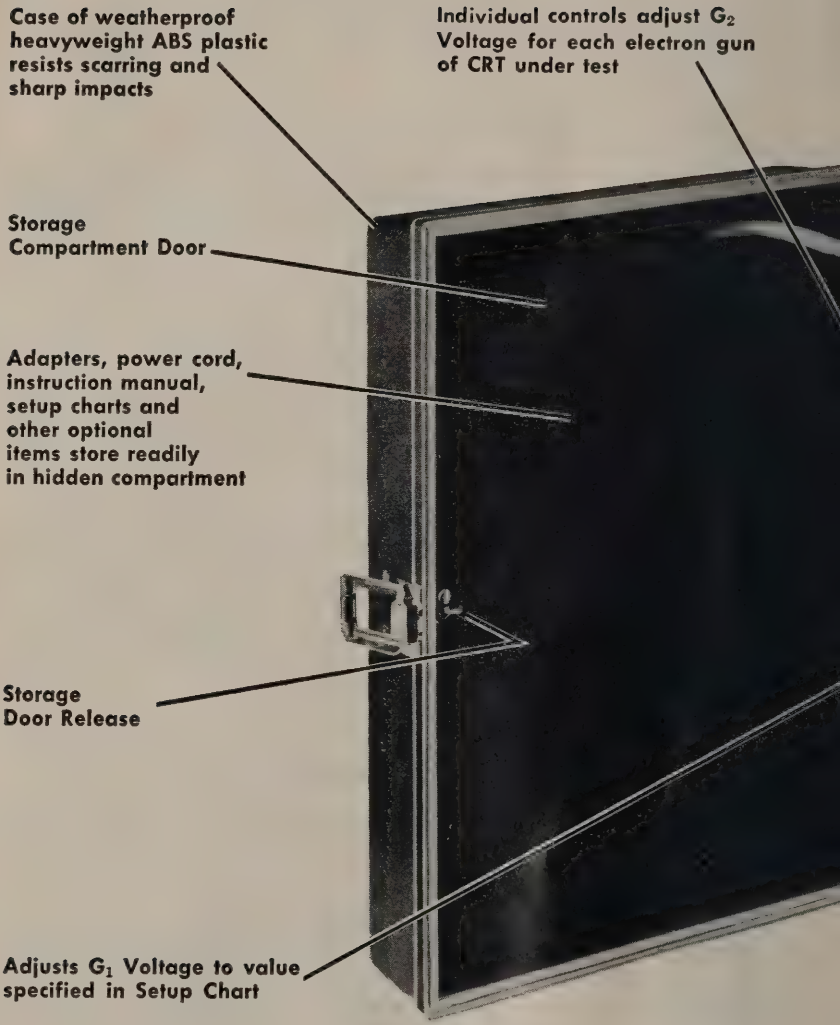
16. New improved, expanded, more versatile adapter set is included and provides capability to directly test more CRT types than any other currently available tester. For example, even the new Trinitron, 11SP22 and 11WP22 tubes are accurately tested on the 466 without having to obtain additional adapters at added cost.

17. Unlike other CRT testers which allow some of the internal elements of a color CRT under test to "float at random" or to be shorted together (to reduce cost of the tester), in all test modes the 466 insures that all key elements of the color CRT are properly connected to appropriate test circuit points. This permits greater precision in test results and eliminates the real possibility of any uncontrolled, internal current paths injuring the CRT under test.

Safety Precautions

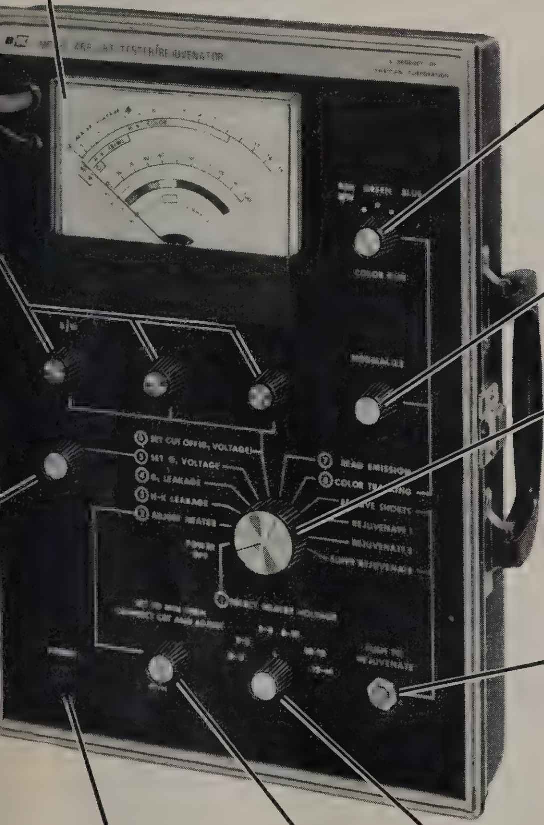
NOTE: The proper power line supply voltage is indicated in the line cord storage compartment. Do not attempt to operate this instrument from a power source other than specified.

When testing any CRT that is installed in a chassis, first disconnect the chassis power plug from the AC line outlet. DO NOT APPLY POWER TO THE CHASSIS AT ANY TIME DURING THE TEST OF THE CRT. Remove the receiver female socket assembly from the base of the CRT. Always perform test steps carefully.


Case of weatherproof heavyweight ABS plastic resists scarring and sharp impacts
Individual controls adjust G_2 Voltage for each electron gun of CRT under test
Storage Compartment Door
Adapters, power cord, instruction manual, setup charts and other optional items store readily in hidden compartment
Storage Door Release
Adjusts G_1 Voltage to value specified in Setup Chart

BASIC FEATURES OF MODEL 466

Meter scales are sequentially numbered with circled numbers which tie in with circled numbers on step-by-step front panel of 466 tester.



Color Gun Switch selects electron gun to be tested, activated or rejuvenated. See instructions.

Normalize Control simplifies Color Tracking test

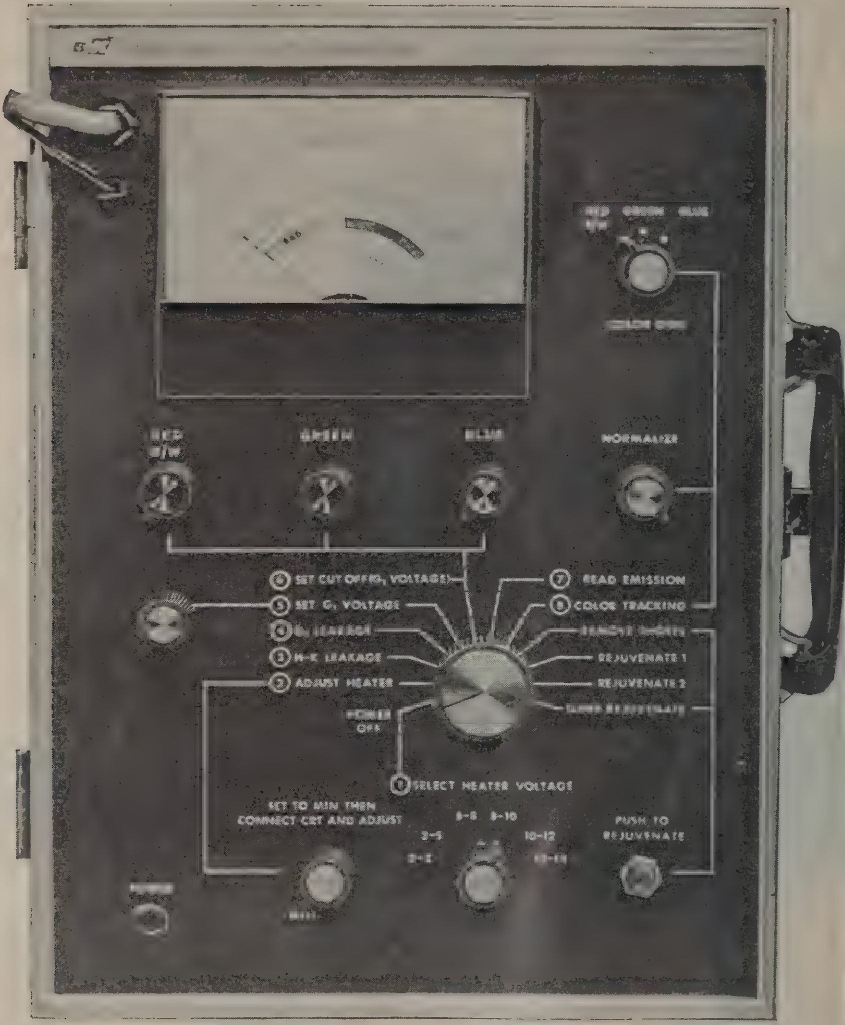
LARGE CENTRAL FUNCTION KNOB CONTROLS STEP-BY-STEP SEQUENCE OF TESTING

RED REJUVENATE PUSHBUTTON (read instructions before using).

Power On Indicator

Adjusts Heater Voltage to Exact Value specified in Setup Chart

Selects Heater Voltage Range



CONTROL PANEL OF MODEL 466

PREPARATION FOR TEST

Connect line cord of tester to proper power line outlet, rotate NORMALIZE control completely clockwise and all other controls completely counterclockwise. Find the listing in the test chart for the CRT to be tested. Note the sequential numbering on the front panel of the 466 which will guide you rapidly through the test sequence. Circled numbers below correlate with circled numbers on panel and meter of tester.

The 466 tests both black-and-white and color CRTs in an essentially identical manner, except that the top switch marked COLOR GUN is always kept in the position marked RED/B&W for a black-and-white tube but is switched into each of its three color gun positions for steps ③, ④ ⑥, and ⑦ when testing a color CRT.

SIMPLIFIED TEST PROCEDURE

① Rotate bottom knob marked ① SELECT HEATER VOLTAGE to proper range as indicated in setup chart.

② Rotate large central function knob to position marked ② ADJUST HEATER. Follow guideline, set small knob to MIN, select adapter indicated in chart, connect CRT, adjust heater voltage as indicated on scale ② of meter to value given in chart. Allow CRT to warmup for at least three minutes. Readjust heater voltage.

SET HEATER

③ Rotate the large function knob to ③ H-K LEAKAGE and observe reading on LEAKAGE scale ③ of meter. (There are two scales for H-K leakage. One is for color CRTs and the other for black-and-white CRTs. Be sure to take your reading from the appropriate scale for the type of CRT under test). The colored area indicates the range of permissable leakage. Readings outside this area indicate a defective tube. For a color CRT repeat this step for all positions of the COLOR GUN switch.

④ Rotate the large function knob to ④ G_1 LEAKAGE. Observe meter reading on scale ④. For a color CRT repeat this step for all positions of the COLOR GUN switch. For both black-and-white and color tubes, if the reading is outside the colored area, the tube is defective and should be rejected.

COMMENTS:

Tap lightly on the neck of the tube during the above leakage tests ③ and ④. Erratic meter readings may indicate an intermittent or short condition. Leakage can be caused by an accumulation of dust at the base pins of the CRT. Cleaning the tube base with a non-toxic, non-conductive solvent such as methyl alcohol, will frequently remedy this problem.

LEAKAGE & SHORTS TEST

EMISSION TEST

⑤ **Set large function knob to ⑤ SET G_1 VOLTAGE and using knob ⑤ adjust G_1 voltage on meter scale ⑤ to green line = 45 volts. *For tubes marked with an asterisk *, set G_1 to 70 volts.**

⑥ **Set large function knob to position ⑥ and with COLOR GUN switch in position marked RED/B&W adjust B/W RED G_2 voltage control knob until meter pointer reading on meter scale ⑥ increases by two small divisions. (If pointer is beyond limit of scale ⑥ or if you can't adjust pointer by two divisions on scale ⑥, CRT is bad.) For a color CRT perform this step once for each of the three positions of the COLOR GUN switch, using the corresponding control.**

⑦ **Set function switch to ⑦ READ EMISSION and evaluate the emission on meter scale ⑦. If meter reads BAD, reject the tube. If meter reads GOOD, cathode emission is acceptable. For a color CRT, perform this step in all three positions of COLOR GUN switch.**

The following step applies only to color CRTs.

COLOR TRACKING

⑧ **a. Set function switch to ⑧ COLOR TRACKING position.**

b. While observing meter pointer, rotate COLOR GUN switch in all three positions, then set to gun with highest reading on meter.

c. Adjust NORMALIZE control until meter pointer aligns on the right edge of the color tracking rectangle (marked NORMALIZE).

d. Switch the COLOR GUN switch to each of the other two color guns. If the meter does not read within the boundaries of the color tracking rectangle for all three guns, reject the tube if IN-WARRANTY. If tube is OUT-OF-WARRANTY, consider using ACTIVATE/REJUVENATE procedure for the color gun having the lowest emission reading.

COMMENTS

A zero reading when the Function Switch is in the READ EMISSION position ⑦ indicates an open G_2 or K element. The G_2 voltage control ⑥ should be set carefully so that erroneous reading and tube damage are avoided.

SIMPLIFIED WARMUP TEST FOR COLOR TUBES

To produce satisfactory colors in operation, the emission of each of the three guns of a color picture tube must approach its normal operating value within a reasonable time period. One of the unique features of the 466 is that it provides a very easy, simplified technique for determining the warmup characteristics of color tubes as follows.

1. After the standard test steps ① thru ⑦ and the Color Tracking evaluation step ⑧ have been completed on a color tube and the tube has been evaluated as acceptable, leave all settings of the small knobs unchanged and rotate the large function knob to the OFF position for 10 minutes or until CRT cools down completely.
2. Leaving all small knobs still undisturbed, rotate large function knob back to position marked COLOR TRACKING. Wait 2 minutes and then successively rotate the COLOR GUN switch into all three of its positions while observing meter position relative to the acceptable tracking area indicated on scale ⑧ of the meter. If the meter needle deflects into the acceptable color tracking rectangle of scale ⑧ for all guns at the two minute point, the warmup characteristic of the CRT is considered to be acceptable.
3. If any gun failed step ②, above, wait two more minutes and then (leaving all other controls still undisturbed) again rotate the COLOR GUN switch into all three positions while observing meter. If the meter needle deflects into the acceptable color tracking rectangle for all three guns at this time (after a total of four minutes of warmup), the warmup characteristic of the CRT is considered to be marginally acceptable.

LIFE TEST

1. Set the function switch to position ⑦ READ EMISSION until CRT is up to operating temperature.

2. Rotate bottom right knob ① SELECT HEATER VOLTAGE to lowest range. Note the length of time before the meter needle starts to fall toward zero as the CRT cools down.

3. When testing a color tube, repeat steps ①, and ② for all three color guns.

4. If the meter needle momentarily remains fixed or slightly increases and then slowly drops to zero, the tube is accepable. If the meter needle begins to slump toward zero rapidly, then the tube cannot be expected to last much longer.

Note: The emission current in "instant on" CRTs (not preheated filaments) can be expected to decrease quite rapidly, since the thermal time constant of the gun structure is much smaller than for conventional CRTs.

Comment: In this test, the useful life of a picture tube is approximately correlated with the "statistical probability" of electrons being emitted from the cathode surface and passing through the aperture of the electron gun. This, in turn, depends on whether the small portion of the cathode surface nearest the aperture can emit electrons efficiently.
If there is excess gas in the tube, positive ions will have been drawn through the aperture to this crucial portion of the cathode surface. These ions, on striking the cathode surface, "borrow" electrons from the cathode and become atoms attached to the cathode surface. These "contaminating" atoms thus coat the emission surface with a barrier layer which reduces the "statistical probability" that electrons will be emitted as desired. The slump in current (if observed in step 2) indicates this surface contamination. Since the contamination will continue to increase in a "gassy" tube, such a tube cannot be expected to last much longer. A continuing degradation of the emission current can be expected.

REMOVING SHORTS

1. Set large function switch to REMOVE SHORTS position.
2. Allow five to ten minutes for the filament to cool. Heater voltage is not applied to the tube during this function.
3. When repairing a color tube, set the COLOR GUN switch to the gun being repaired. For a black-and-white tube, set the switch to the B/W position.
4. Press red REJUVENATE pushbutton momentarily.
5. Repeat the SHORTS test steps ③ and ④ to determine whether or not the short has been removed. If a short has been removed, proceed with emission test (steps ⑤ thru ⑦).

COMMENTS: When the tube in the Shorts test shows a cathode to filament short, do not attempt to repair it. If the tube functions properly in the set, it is unnecessary to do any more to it. However, if the picture is bad (due to possible hum in the picture or no control of brightness), the picture tube can still be used if a 1:1 filament isolation tranformer is wired into the set.

ACTIVATE MODE

The activate mode of the Model 466 comprises a mild form of rejuvenation and can be used to increase the emission of some picture tubes when the emission has decreased below the acceptable level. All tubes with low emission cannot be activated—it depends on the condition of the cathode emission surface in the particular tube.

During the activate mode, the heater voltage of the tube is increased, while the emission current flow is maintained. The relative cathode emission can be observed on the meter of the 466 as the tube is activated. Note: Activation of in-warranty color tubes should not be performed.

Activate Procedure

1. After completing normal test steps ① thru ⑦, note emission reading, then rotate function knob back to ② and adjust heater voltage to a value 40% above value specified in setup chart. (Example: If setup chart specified 6.3 v., adjust heater to 1.4 x 6.3 v. = 8.8 v.).

2. Rotate function knob to position ⑦ and note emission reading on meter. Allow the CRT to activate for 5 minutes, while noting the meter deflection. If the pointer moves upward and stabilizes at a higher reading, it is probable that the tube has been activated to the extent possible.

3. Rotate function knob to OFF and wait one minute. Repeat normal steps ②, ③ and ④.

NOTE: Picture tube leakage reading may change after the tube is activated. Allow tube to cool a few minutes until original leakage reading is restored, then perform steps ⑤, ⑥ and ⑦ and note emission reading. If emission is still too low and CRT is out-of-waranty, consider performing Rejuvenation Procedure outlined below.

RESTORING EMISSION

NOTE: Any attempt to bring back the emission by rejuvenating a tube should be done very cautiously, AND ONLY AFTER IT HAS BEEN DEFINITELY DETERMINED THAT THE TUBE IS NO LONGER USEFUL IN ITS PRESENT CONDITION. When rejuvenating a Color tube, make sure you attempt rejuvenation of the defective gun only. Always follow carefully the procedure outlined below.

It is not generally advisable that you attempt rejuvenation of an "in-warranty" tube.

REJUVENATION

1. Set the large function switch to the REJUVENATE 1 position.

2. When repairing a color tube, set the COLOR GUN switch to the gun that is to be rejuvenated. For a black-and-white tube, set the COLOR GUN switch in the "B/W" position. Note precisely the meter pointer position.

3. Press the red REJUVENATE button momentarily. Observe new meter needle position. Repeat step until needle deflects into GOOD area of scale ⑦ or until pointer deflection fails to increase from the previous reading.

4. If meter pointer fails to indicate in GOOD area after Step 3, rotate large function knob to REJUVENATE 2 position, wait 15 seconds for heater

to come up to its new operating temperature, note new meter reading, then momentarily press red REJUVENATE pushbutton. Repeat step until meter reading fails to increase. Do not continue the REJUVENATE process beyond the point where the meter needle ceases to indicate increased relative emission after each release of the REJUVENATE pushbutton.

5. If Steps 3 and 4 (which provide an automatically timed rejuvenate cycle) did not bring the cathode emission to the acceptable level, you have the option of proceeding to the SUPER REJUVENATE step. This last step is manually controlled in duration by the red REJUVENATE pushbutton, when you rotate the large function knob into the SUPER REJUVENATE position.

SUPER REJUVENATION

With function switch in SUPER REJUVENATE position note meter needle position, then press red REJUVENATE button for ¼ to ½ second and release immediately. Observe new meter reading. If emission is still inadequate, wait at least 5 seconds and repeat step until emission fails to increase. Increase time of rejuvenation to 1 or 2 seconds until some improvement in emission is obtained. This SUPER REJUVENATE is not an automatically timed position, so the longer you hold down the red REJUVENATE button, the longer the SUPER REJUVENATE cycle will continue.

DO NOT CONTINUE CYCLING IN ANY REJUVENATE STEP IF THE METER READING DECREASED SLIGHTLY AFTER THE LAST DEPRESSION OF THE RED REJUVENATE PUSHBUTTON. For a SHORTED CRT NEVER USE SUPER REJUVENATE MODE.

NOTE: To avoid accidental application of REJUVENTE voltages to a normal CRT, NEVER LEAVE FUNCTION KNOB IN ANY REJUVENATE POSITION MARKED IN GOLD unless you intend to immediately perform that specific rejuvenation step.

REPAIRING OPEN ELEMENTS

If the tube has an open G_1 or G_2 element, the probable cause is a bad solder connection at the base pins of the picture tube. For an open element, the first step is to try resoldering the base pins. If the tube has an open cathode, it may actually be a break in the weld between the cathode and its connecting tab or very weak emission from the cathode. First, try restoring emission as discussed in "Restoring Emission". If rejuvenation does not help, an attempt can be made to weld the cathode tab as follows:

Turn function switch to Rejuvenate 2 position. With the non-metallic handle of a screwdriver, tap the neck of the tube lightly. Carefully watch as you press the red REJUVENATE button. If the weld takes you will see a bright flash. If the weld does not take, set function knob in SUPER REJUVENATE position and press red REJUVENATE button while lightly tapping neck of CRT. If the weld takes, you will see a bright flash. IMMEDIATELY RELEASE RED PUSHBUTTON. Retest the tube to be sure it will function satisfactorily.

NOTE: When not actively using the 466, rotate the large function knob to the POWER OFF position. Do not pinch line cord between mating aluminum edge extrusions of case when closing cover.

SETUP CHARTS

An up-to-date test chart is included with your Model 466. In order to keep your setup chart up-to-date, it is recommended that you subscribe to the B&K Chart mailing service. These mailings will occur in May and November of each year and will include all the tubes presently listed on your chart plus all new types of CRTs that have come out since the last mailing.

If you wish to take advantage of this service, remit cash, check, or money order (no COD's please) to:

B&K Division of Dynascan Corporation
1801 West Belle Plaine Avenue
Chicago, Illinois 60613

and you will be placed on the subscription list.

466 FIELD CALIBRATION

The Model 466 CRT Tester/Rejuvenator can be recalibrated as follows:

A. HEATER VOLTAGE CALIBRATION

Equipment Needed: An accurate A.C. VOM or VTVM.
Set meter for the AC scale that gives closest full scale reading to 6.3 VAC. Connect meter leads to pins 1 and 12 of socket #1. Plug the 466 line cord into a 117 VAC outlet. Turn the large function switch to the ADJUST HEATER position. Turn the heater selector switch to 5-8 position. Turn the heater adjust pot until the VOM/VTVM reads 6.3 VAC. Adjust R_1, the heater cal trim pot until the 466 meter reads 6.3 VAC on scale ②.

B. EMISSION CALIBRATION

Equipment Needed: A milliammeter and a 100K resistor.
Turn the 466 large function switch to the READ EMISSION position. Turn the color gun switch to the RED-B/W position. Turn the G_2 pots (RED-GREEN-BLUE) to full counterclockwise positions. Set the milliammeter to a range capable of reading 300 microamperes. Connect the negative lead to pin 11 of socket #1. Connect the positive lead to one end of the 100K resistor. Connect the other end of the resistor to pin 10 of socket #1. Slowly turn the red G_2 pot until the milliammeter reads $300\mu a$. Adjust R9, the emission cal trim pot, until the 466 meter reads 50 on scale ⑤.

C. COMPRESSION CALIBRATION

Equipment Needed: A milliammeter and a 100K resistor.
Turn the 466 large function switch to the READ EMISSION position. Turn the color gun switch to the RED-B/W position. Turn the G_2 pots (RED-GREEN-BLUE) to full counterclockwise positions. Set the milliammeter to a range capable of reading 3 milliamperes. Connect the negative lead to pin 11 of socket #1. Connect the positive lead to one end of the 100K resistor. Connect the other end of the resistor to pin 10 of socket # 1. Slowly turn the red G_2 pot until the milliammeter reads 3ma. Adjust R4, the compression adjust trim pot, until the 466 meter reads 100 on scale ⑤.

WARRANTY SERVICE INSTRUCTIONS

1. Service information is available from the factory at the address shown below.
2. Defective parts removed from the unit which are within the warranty period should be sent to the factory prepaid with the model and serial numbers of product from which they were removed. Also, include the date your Model 466 was purchased. These parts will be exchanged at no charge.
3. If you are unable to correct a difficulty, pack the product securely (preferably double packed). A detailed list of troubles encountered must be enclosed as well as your name and address. Forward prepaid (express preferred) to the nearest B&K authorized service agency.

Contact your local B&K Distributor for the name and location of your nearest service agency, or write to

Service Department
B&K DIVISION OF DYNASCAN CORPORATION
1801 West Belle Plaine Avenue
Chicago, Illinois 60613

WARRANTY

"B & K warrants that each product manufactured by it will be free from defects in material and workmanship under normal usage and service for a period of ninety days after its purchase new from an authorized B & K distributor. Our obligation under this warranty is limited to repairing, or replacing any product or component which we are satisfied does not conform with the foregoing warranty and which is returned to our factory or our authorized service contractor, transportation prepaid, and we shall not otherwise be liable for any damages, consequential or otherwise. *The foregoing warranty is exclusive and in lieu of all other warranties (including any warranty of merchantability), whether expressed or implied.* Such warranty shall not apply to any product or component (i) repaired or altered by anyone other than B & K or its authorized service contractor (except normal tube replacement) without B & K's prior written approval; (ii) tampered with or altered in any way or subjected to misuse, negligence or accident; (iii) which has the serial number altered, defaced or removed; or (iv) which has been improperly connected, installed or adjusted otherwise than in accordance with B & K's instructions. B & K reserves the right to discontinue any model at any time or change specifications or design without notice and without incurring any obligation. *The warranty shall be void and there shall be no warranty of any product or component if a B & K warranty registration card is not properly completed and postmarked to the B & K factory within five days after the purchase of the product new from an authorized B & K distributor.*"

DYNASCAN CORPORATION
1801 West Belle Plaine Avenue, Chicago, Illinois 60613

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COLOR GENERATOR

Model 850

B&K

INSTRUCTION MANUAL

for

[illegible]

B·& K MANUFACTURING COMPANY
DIVISION OF DYNASCAN CORPORATION
1801 W. BELLE PLAINE AVENUE, CHICAGO 13, ILLINOIS

INSTRUCTION MANUAL

FOR

Model 850
Color Generator

B & K MANUFACTURING COMPANY
DIVISION OF DYNASCAN CORPORATION

1801 West Belle Plaine Avenue
Chicago 13, Illinois

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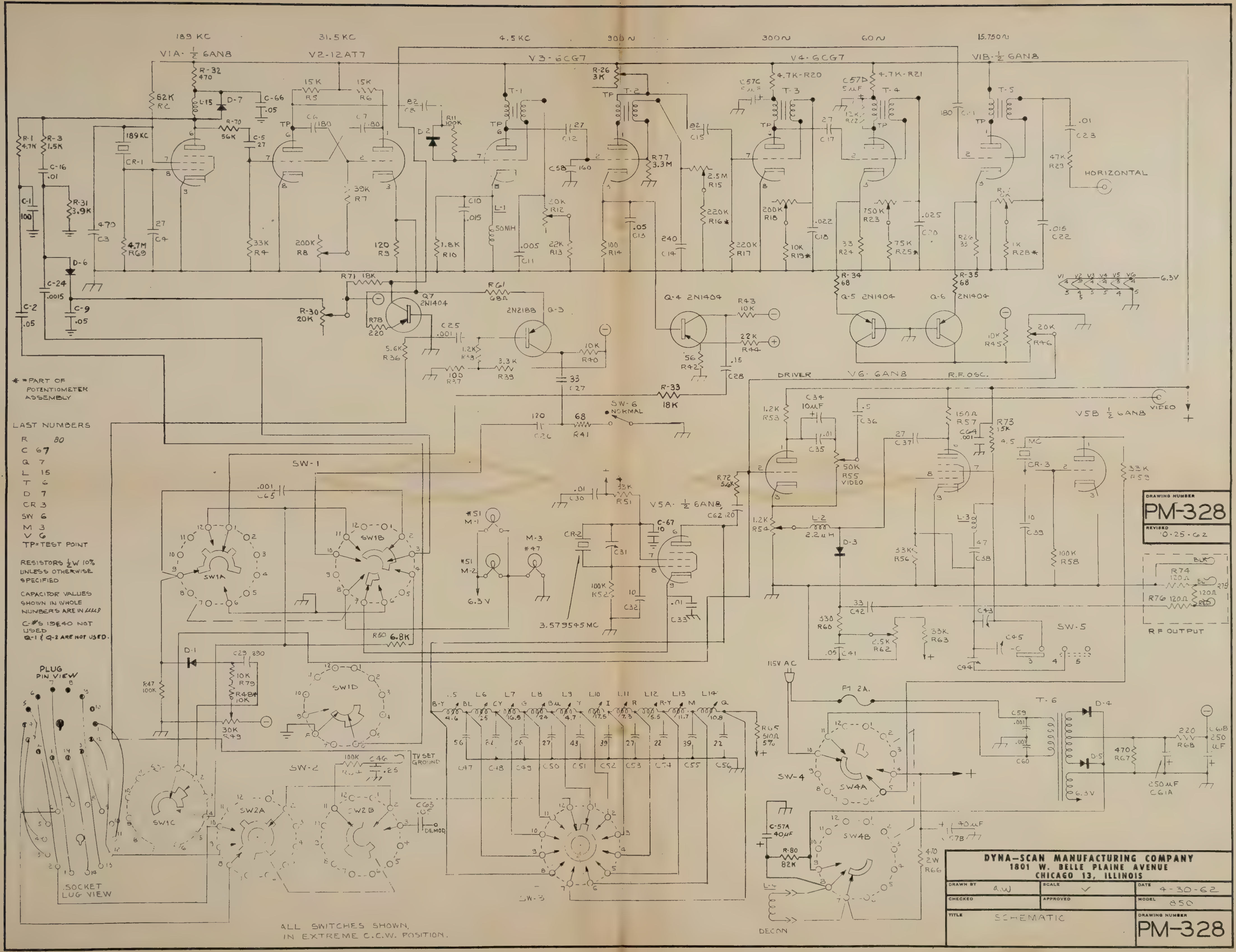


* = PART OF POTENTIOMETER ASSEMBLY

LAST NUMBERS

R	80
C	67
Q	7
L	15
T	6
D	7
CR	3
SW	6
M	3
V	6

TP = TEST POINT

RESISTORS ½W 10% UNLESS OTHERWISE SPECIFIED

CAPACITOR VALUES SHOWN IN WHOLE NUMBERS ARE IN μμf

C-#'s 19 & 40 NOT USED
Q-1 & Q-2 ARE NOT USED.

DRAWING NUMBER
PM-328
REVISED
10-25-62

DYNA–SCAN MANUFACTURING COMPANY
1801 W. BELLE PLAINE AVENUE
CHICAGO 13, ILLINOIS

DRAWN BY a.w
SCALE ✓
DATE 4-30-62
CHECKED
APPROVED
MODEL 850
TITLE SCHEMATIC
DRAWING NUMBER PM-328

B & K MODEL 850 PARTS AND PRICE LIST

CAPACITORS

SCHEMATIC SYMBOL	DESCRIPTION	B & K PART No.	DEALER'S NET
C-1	100 PF @ 500V ± 20% Disc. Ceramic	CC-101-500-20	.07
C-2	.05 MFD @ 400V ± 20% Disc Ceramic	CC-A05-400-20	.21
C-3	470PF 500WV, Polystyrene Cap.	CPO-471-500-5	.12
C-4	27PF ± 5%, 500 WV, Polystyrene Cap.	CPO-270-500-5	.12
C-5	27PF ± 5%, 500 WV, Polystyrene Cap.	CPO-270-500-5	.12
C-6	180PF ± 5%, 500WV, Polystyrene Cap.	CPO-181-500-5	.12
C-7	180PF ± 5%, 500WV, Polystyrene Cap.	CPO-181-500-5	.12
C-8	82PF ± 5%, 500WV, Polystyrene Cap.	CPO-820-500-5	.12
C-9	.05 MFD @ 400V ± 20% Disc Ceramic	CC-A05-400-20	.21
C-10	.015 MFD @ 500V ± 5% Disc. Ceramic	CPO-A015-500-5	.21
C-11	.005 MFD @ 500V ± 5% Disc. Ceramic	CPO-A005-500-5	.15
C-12	27PF @ 500V ± 5% Disc. Ceramic	CPO-270-500-5	.12
C-13	.05 MFD @ 400V ± 20% Disc. Ceramic Cap.	CC-A05-400-20	.21
C-14	240PF @ 500V ± 5% Polystyrene Cap.	CPO-241-500-5	.12
C-15	82PF @ 500V ± 5% Polystyrene Cap.	CPO-820-500-5	.12
C-16	.01 MFD @ 500V ± 20% Disc. Ceramic	CC-A01-500-20	.09
C-17	27PF @ 500V ± 5% Polystyrene Cap.	CPO-270-500-5	.12
C-18	.022 MFD @ 500V ± 5% Polystyrene Cap.	CPO-A022-500-5	.27
C-20	.025 MFD @ 500V ± 5% Polystyrene Cap.	CPO-A025-500-5	.27
C-21	180PF @ 500V ± 5% Polystyrene Cap.	CPO-181-500-5	.12
C-22	.015 MFD @ 500V ± 5% Polystyrene Cap.	CPO-A015-500-5	.21
C-23	.01 MFD @ 500V ± 20% Disc. Ceramic	CC-A01-500-20	.09
C-24	.0015 MFD @ 500V ± 20% Disc. Ceramic	CC-A0015-500-20	.07
C-25	.001 MFD @ 500V ± 20% Disc. Ceramic	CC-A001-500-20	.06
C-26	120PF @ 500V ± 20% Disc. Ceramic	CC-121-500-20	.06
C-27	33PF @ 500V ± 20% Disc. Ceramic	CC-330-500-20	.06
C-28	.15 MFD @ 100V ± 20% Paper Cap.	CP-A15-100-20	.21
C-29	390PF @ 500V ± 20% Disc. Ceramic	CC-391-500-20	.06
C-30	.01 MF @ 500V ± 20% Disc. Ceramic	CC-A01-500-20	.09
C-31	3-20 MMF Variable Trimmer, 3.579545 MC Adjust.	CV-3-20	.15
C-32	10PF @ 500V ± 20% NPO Disc. Ceramic	CC-100-500-10 NPO	.09
C-33	.01 MFD @ 500V ± 20% Disc. Ceramic	CC-A01-500-20	.09
C-34	10 MFD @ 175V Electrolytic Cap.	CL-10-175 PC	.63
C-35	.01 MFD @ 500V ± 20% Disc. Ceramic	CC-A01-500-20	.09
C-36	.5 MFD @ 600V ± 20% Paper Cap.	CP-A5-600-20/BKT	.60
C-37	27PF @ 500V ± 20% Disc. Ceramic	CC-270-500-20	.06
C-38	47PF @ 500V ± 10% Disc. Ceramic	CC-470-500-10	.09
C-39	10PF @ 500V ± 10% NPO Disc. Ceramic	CC-100-500-10 NPO	.09
C-41	.05 MFD @ 400V ± 20% Disc. Ceramic	CC-A05-400-20	.21
C-42	33PF @ 500V ± 20% Disc. Ceramic	CC-330-500-20	.06
C-43	3-20 MMF Variable Air Trimmer Chan. 5	CV-3-20	.15
C-44	3-20 MMF Variable Air Trimmer Chan. 4	CV-3-20	.15
C-45	3-20 MMF Variable Air Trimmer Chan. 3	CV-3-20	.15
C-46	.25 MFD @ 600V ± 20% Paper Cap.	CP-A25-600-20/BKT	.45
C-47	56PF @ 500V ± 2½ % Polystyrene Cap.	CPO-560-500-2A5	.12
C-48	82PF @ 500V ± 2½ % Polystyrene Cap.	CPO-820-500-2A5	.12
C-49	56PF @ 500V ± 2½ % Polystyrene Cap.	CPO-560-500-2A5	.12
C-50	27PF @ 500V ± 2½ % Polystyrene Cap.	CPO-270-500-2A5	.12
C-51	43PF @ 500V ± 2½ % Polystyrene Cap.	CPO-430-500-2A5	.12
C-52	39PF @ 500V ± 2½ % Polystyrene Cap.	CPO-390-500-2A5	.12
C-53	27PF @ 500V ± 2½ % Polystyrene Cap.	CPO-270-500-2A5	.12
C-54	22PF @ 500V ± 2½ % Polystyrene Cap.	CPO-220-500-2A5	.12
C-55	39PF @ 500V ± 2½ % Polystyrene Cap.	CPO-390-500-2A5	.12
C-56	22PF @ 500V ± 2½ % Polystyrene Cap.	CPO-220-500-2A5	.12
C-57A C-57B C-57C C-57D	40 MFD @ 200V, 40 MFD @ 200V, 5 MFD @ 200V, 5 MFD @ 200V, Quadruple Section Electrolytic Can. Cap.	CL-40-40-5-5	2.04
C-58	160PF @ 500V ± 5% Polystyrene Cap.	CPO-161-500-5	.12
C-59	.001 MFD @ 500V ± 20% Disc. Ceramic	CC-A001-500-20	.06
C-60	.001 MFD @ 500V ± 20% Disc. Ceramic	CC-A001-500-20	.06
C-61A	250 MFD @ 25WV Common Positive		
C-61B	Electrolytic Cap.	CL-250-250/25CP	2.19
C-62	120PF @ 500V ± 20% Disc. Ceramic	CC-121-500-20	.06
C-63	.05 MFD @ 400V ± 20% Disc. Ceramic	CC-A05-400-20	.21
[illegible]64	.001 MFD @ 500V ± 20% Disc. Ceramic	CC-A001-500-20	.06
[illegible]65	.001 MFD @ 500V ± 20% Disc. Ceramic	CC-A001-500-20	.06
C-66	.05 MFD @ 400V ± 20% Disc. Ceramic	CC-A05-400-20	.21
C-67	10 PF @ 500V ± 10% Disc. Ceramic	CC-100-500-10	.08

ITEMS SUPPLIED WITH YOUR MODEL 850

1. 1 R.F. Cable.
2. 1 Red and 1 Black Test Lead.
3. 1 Deconvergence Assembly.
4. 1 Gun Killer and Demodulator Socket Assembly.
5. 1 Cover with Mirror.
6. 1 Instruction Book.
7. 1 Registration Card.
8. 1 Schematic Diagram and Parts List.

SPECIFICATIONS — MECHANICAL

WEIGHT: *	13 lbs.
WIDTH: *	12¾″
HEIGHT: *	9″
DEPTH: *	9″

*SPECIFICATIONS INCLUDE COVER WITH MIRROR.

B & K MODEL 850 PARTS AND PRICE LIST

CAPACITORS

SCHEMATIC SYMBOL	DESCRIPTION	B & K PART No.	DEALER'S NET
C-1	100 PF @ 500V ± 20% Disc. Ceramic	CC-101-500-20	.07
C-2	.05 MFD @ 400V ± 20% Disc Ceramic	CC-A05-400-20	.21
C-3	470PF 500 WV, Polystyrene Cap	CPO-471-500-5	.12
C-4	27PF ± 5%, 500 WV, Polystyrene Cap	CPO-270-500-5	.12
C-5	27PF ± 5%, 500 WV, Polystyrene Cap	CPO-270-500-5	.12
C-6	180PF ± 5%, 500WV, Polystyrene Cap	CPO-181-500-5	.12
C-7	180PF ± 5%, 500WV, Polystyrene Cap	CPO-181-500-5	.12
C-8	82PF ± 5%, 500WV, Polystyrene Cap	CPO-820-500-5	.12
C-9	.05 MFD @ 400V ± 20% Disc Ceramic	CC-A05-400-20	.21
C-10	.015 MFD @ 500V ± 5% Disc. Ceramic	CPO-A015-500-5	.21
C-11	.005 MFD @ 500V ± 5% Disc. Ceramic	CPO-A005-500-5	.15
C-12	27PF @ 500V ± 5% Disc. Ceramic	CPO-270-500-5	.12
C-13	.05 MFD @ 400V ± 20% Disc. Ceramic Cap	CC-A05-400-20	.21
C-14	240PF @ 500V ± 5% Polystyrene Cap	CPO-241-500-5	.12
C-15	82PF @ 500V ± 5% Polystyrene Cap	CPO-820-500-5	.12
C-16	.01 MFD @ 500V ± 20% Disc. Ceramic	CC-A01-500-20	.09
C-17	27PF @ 500V ± 5% Polystyrene Cap	CPO-270-500-5	.12
C-18	.022 MFD @ 500V ± 5% Polystyrene Cap	CPO-A022-500-5	.27
C-20	.025 MFD @ 500V ± 5% Polystyrene Cap	CPO-A025-500-5	.27
C-21	180PF @ 500V ± 5% Polystyrene Cap	CPO-181-500-5	.12
C-22	.015 MFD @ 500V ± 5% Polystyrene Cap	CPO-A015-500-5	.21
C-23	.01 MFD @ 500V ± 20% Disc. Ceramic	CC-A01-500-20	.09
C-24	.0015 MFD @ 500V ± 20% Disc. Ceramic	CC-A0015-500-20	.07
C-25	.001 MFD @ 500V ± 20% Disc. Ceramic	CC-A001-500-20	.06
C-26	120PF @ 500V ± 20% Disc. Ceramic	CC-121-500-20	.06
C-27	33PF @ 500V ± 20%Disc. Ceramic	CC-330-500-20	.06
C-28	.15 MFD @ 100V ± 20% Paper Cap	CP-A15-100-20	.21
C-29	390PF @ 500V ± 20% Disc. Ceramic	CC-391-500-20	.06
C-30	.01 MF @ 500V ± 20% Disc. Ceramic	CC-A01-500-20	.09
C-31	3-20 MMF Variable Trimmer, 3.579545 MC Adjust	CV-3-20	.15
C-32	10PF @ 500V ± 20% NPO Disc. Ceramic	CC-100-500-10 NPO	.09
C-33	.01 MFD @ 500V ± 20% Disc. Ceramic	CC-A01-500-20	.09
C-34	10 MFD @ 175V Electrolytic Cap	CL-10-175 PC	.63
C-35	.01 MFD @ 500V ± 20% Disc. Ceramic	CC-A01-500-20	.09
C-36	.5 MFD @ 600V ± 20% Paper Cap	CP-A5-600-20/BKT	.60
C-37	27PF @ 500V ± 20% Disc. Ceramic	CC-270-500-20	.06
C-38	47PF @ 500V ± 10% Disc. Ceramic	CC-470-500-10	.09
C-39	10PF @ 500V ± 10% NPO Disc. Ceramic	CC-100-500-10 NPO	.09
C-41	.05 MFD @ 400V ± 20% Disc. Ceramic	CC-A05-400-20	.21
C-42	33PF @ 500V ± 20% Disc. Ceramic	CC-330-500-20	.06
C-43	3-20 MMF Variable Air Trimmer Chan. 5	CV-3-20	.15
C-44	3-20 MMF Variable Air Trimmer Chan. 4	CV-3-20	.15
C-45	3-20 MMF Variable Air Trimmer Chan. 3	CV-3-20	.15
C-46	.25 MFD @ 600V ± 20% Paper Cap	CP-A25-600-20/BKT	.45
C-47	56PF @ 500V ± 2½% Polystyrene Cap	CPO-560-500-2A5	.12
C-48	82PF @ 500V ± 2½% Polystyrene Cap	CPO-820-500-2A5	.12
C-49	56PF @ 500V ± 2½% Polystyrene Cap	CPO-560-500-2A5	.12
C-50	27PF @ 500V ± 2½% Polystyrene Cap	CPO-270-500-2A5	.12
C-51	43PF @ 500V ± 2½% Polystyrene Cap	CPO-430-500-2A5	.12
C-52	39PF @ 500V ± 2½% Polystyrene Cap	CPO-390-500-2A5	.12
C-53	27PF @ 500V ± 2½% Polystyrene Cap	CPO-270-500-2A5	.12
C-54	22PF @ 500V ± 2½% Polystyrene Cap	CPO-220-500-2A5	.12
C-55	39PF @ 500V ± 2½% Polystyrene Cap	CPO-390-500-2A5	.12
C-56	22PF @ 500V ± 2½% Polystyrene Cap	CPO-220-500-2A5	.12
C-57A	40 MFD @ 200V, Quadruple Section Electrolytic Can. Cap	CL-40-40-5-5	2.04
C-57B	40 MFD @ 200V,		
C-57C	5 MFD @ 200V,		
C-57D	5 MFD @ 200V,		
C-58	160PF @ 500V ± 5% Polystyrene Cap	CPO-161-500-5	.12
C-59	.001 MFD @ 500V ± 20% Disc. Ceramic	CC-A001-500-20	.06
C-60	.001 MFD @ 500V ± 20% Disc. Ceramic	CC-A001-500-20	.06
C-61A	250 MFD @ 25WV Common Positive		
C-61B	Electrolytic Cap	CL-250-250 25CP	2.19
C-62	120PF @ 500V ± 20% Disc. Ceramic	CC-121-500-20	.06
C-63	.05 MFD @ 400V ± 20% Disc. Ceramic	CC-A05-400-20	.21
C-64	.001 MFD @ 500V ± 20% Disc. Ceramic	CC-A001-500-20	.06
C-65	.001 MFD @ 500V ± 20% Disc. Ceramic	CC-A001-500-20	.06
C-66	.05 MFD @ 400V ± 20% Disc. Ceramic	CC-A05-400-20	.21
C-67	10 PF @ 500V ± 10% Disc. Ceramic	CC-100-500-10	.08

RESISTORS—CONTROLS

SCHEMATIC SYMBOL	DESCRIPTION	B & K PART No.	DEALER'S NET
R-8	200K Ohms, 31.5KC Adjust	P-99	1.41
R-12	20K Ohms, 4.5KC Adjust		
R-15	2.5 Meg. 900 Cycle Adjust		
R-27	10K Ohms, 15,750 Cycle Adjust		
R-16	220K Ohms, Fixed Resistance Built In		
R-28	1K Ohms, Fixed Resistance		
R-18	200K Ohms Variable, 300 Cycle Adjust	P-100	.93
R-19	10K Ohms Fixed Resistance		
R-23	750K Ohms Variable, 60 Cycle Adjust		
R-25	75K Ohms Fixed Resistance		
R-26	3K Ohm W.W. 900 Cycle Pulse Width	P-81	.32
R-30	20K Ohms Variable, 189KC Adjust	P-101	.84
R-49	30K Ohms Variable, Dot Adjust		
R-48	10K Fixed		
R-46	20K Ohms Variable, Driver Grid Adjust	P-102	1.02
R-54	1.2K Ohms Variable, Driver Mod. Adjust		
R-62	2.5K Ohms Variable, Mod. Diode Adjust		
R-55	50K Ohms Video Control	P-103	.51

CHOKES—COILS—TRANSFORMERS

SCHEMATIC SYMBOL	DESCRIPTION	B & K PART No.	DEALER'S NET
L-1	50 Millihenry R.F.C.	L-47	.45
L-2	3.3 Microhenry Peaking Coil	CH-8	.24
L-3	R.F. OSC. Coil	L-46	.15
L-4	Deconvergence Coil Available Only as Assembly. See Misc.		
L-5	Bottom, 4.6 UH Delay Line	L-41	.48
L-6	Top, 25 UH Delay Line Yellow-Black Dot		
L-7	Bottom, 16.5 UH Delay Line	L-42	.48
L-8	Top, 24 UH Delay Line Yellow-Red Dot		
L-9	Bottom, 4.7 UH Delay Line	L-43	.48
L-10	Top, 17.5 UH Delay Line Yellow-Orange Dot		
L-11	Bottom, 7.3 UH Delay Line	L-44	.48
L-12	Top, 5.5 UH Delay Line Yellow-Yellow Dot		
L-13	Bottom, 11.7 UH Delay Line	L-45	.48
L-14	Top, 10.8 UH Delay Line Yellow-Green Dot		
L-15	1 Mh R. F. Choke	L-50	.23
T-1	4.5 KC B.O. Transformer	TO-7	1.65
T-2	900 Cycle B.O. Transformer	TO-8	1.83
T-3	300 Cycle B.O. Transformer	TO-8	1.83
T-4	60 Cycle B.O. Transformer	TO-8	1.83
T-5	15,750 Cycle B.O. Transformer	TO-7	1.65
T-6	Power Transformer	TP-35	3.75

SWITCHES

SCHEMATIC SYMBOL	DESCRIPTION	B & K PART No.	DEALER'S NET
SW-1	Pattern Switch	S-73	1.50
SW-2	Gun Killer Switch	S-74	1.17
SW-3	Color Switch	S-75	1.02
SW-4	Power Switch	S-72	[illegible]
SW-5	RF Channel Selector Switch (Rear Panel)	S-77	[illegible]
SW-6	Normal-Color Sync Switch	S-4	.30

CRYSTALS—DIODES—TRANSISTORS

SCHEMATIC SYMBOL	DESCRIPTION	B & K PART No.	DEALER'S NET
CR-1	189KC Crystal	C-11	7.80
CR-2	3.579545 MC Crystal	C-9	3.60
CR-3	4.5 MC Crystal	C-10	3.60
D-1	Diode, Dot Shaper	D-4-25	.34
D-2	Diode, 15,750 Sync Clipper Transistor	D-4-25	.34
D-3	Diode, Modulator	D-4-25	.34
D-4	Silicon Rectifier, D-360	D-360	.57
D-5	Silicon Rectifier, D-360	D-360	.57
D-6	Diode, 189KC Damping	D-4-25	.34
D-7	Diode, 189KC Shaping	D-4-25	.34
Q-3	2N2188 Transistor, Color Shaper (Bottom of Board)	Z-5	1.27
Q-4	2N1404 Transistor, 900 Cycle Shaper (Bottom of Board)	Z-6	.84
Q-5	2N1404 Transistor, 60 Cycle Shaper	Z-6	.84
Q-6	2N1404 Transistor, 15,750 Cycle Shaper	Z-6	.84
Q-7	2N1404 Transistor, 31.5KC Shaper	Z-6	.84

TUBES

SCHEMATIC SYMBOL	DESCRIPTION	B & K PART No.	DEALER'S NET
V-1	6AN8 (189KC Osc. and 15750 Blocking Osc.)	V-6AN8	1.96
V-2	12AT7 (31.5KC Multivibrator)	V-12AT7	1.62
V-3	6CG7 (4.5KC and 900 Cycle Blocking Osc.)	V-6CG7	1.30
V-4	6CG7 (300 Cycle and 60 Cycle Blocking Osc.)	V-6CG7	1.30
V-5	6AN8 (3.5 MC Color and 4.5 MC Audio Osc.)	V-6AN8	1.96
V-6	6AN8 (Driver-Osc.)	V-6AN8	1.96

MISCELLANEOUS

SCHEMATIC SYMBOL	DESCRIPTION	B & K PART No.	DEALER'S NET
M-1-2	No. 51 Bulb	PL-8	.12
M-3	No. 47 Bulb	PL-3	.12
F-1	2 Amp. Line Fuse	F-22	.06
	Front Panel Finished	A202-A	2.46
	Case with Handle, Less Lid	ASM-92	11.16
	Lid Assembly	ASM-93	3.84
	Shadow Mask	CA-17	.03
	Black Test Lead	ASM-68	.84
	Red Test Lead	ASM-69	.84
	Deconvergence Assembly—Includes Coil, Brackets, Cord and Clamp	ASM-89	4.56
	Color Killer Cable Assembly	ASM-90	7.86
	R.F. Probe Assembly	ASM-91	4.56
	Fuse Holder	F-1	.21
	Rubber Feet	H-250	.03
	Pattern Wheel Assembly	ASM-96	1.41
	Color Wheel Assembly	ASM-97	3.09
	Black Tip Jack (Video, Ground)	J-33	.09
	Red Tip Jack (Horizontal, Demodulator)	J-34	.09
	Knob, Chrome Insert (Pattern, Color)	K-29	.36
	Knob, (Video, Power, Gun Killer)	H-30	.24
	Carton and Fillers	PKG-96	1.86
	Instruction Book	PM-330	1.00
	Wave Form and Voltage Chart	PM-336	

(Prices subject to change without notice)

NOTE: Standard value resistors are not listed, values may be obtained from schematic diagram.

Minimum charge $1.00 per invoice. Orders will be shipped C.O.D. unless previous account arrangements have been made or remittance accompanies order. Advance remittance must cover postage or express charges.

PM-328A 11-62 RR PRESS

ITEMS SUPPLIED WITH YOUR MODEL 850

1. 1 R.F. Cable.
2. 1 Red and 1 Black Test Lead.
3. 1 Deconvergence Assembly.
4. 1 Gun Killer and Demodulator Socket Assembly.
5. 1 Cover with Mirror.
6. 1 Instruction Book.
7. 1 Registration Card.
8. 1 Schematic Diagram and Parts List.

SPECIFICATIONS — MECHANICAL

WEIGHT: *	13 lbs.
WIDTH: *	12¾″
HEIGHT: *	9″
DEPTH: *	9″

*SPECIFICATIONS INCLUDE COVER WITH MIRROR.

MODEL 850 — COLOR GENERATOR

What The Model 850 Color Generator Will Do:

The basic consideration in the design of the Model 850 was to develop an instrument which would greatly simplify the serviceman's work in setting up and trouble shooting a color TV set.

Once the initial connections are made to the color set, none of the internal controls will have to be adjusted unless they are found to be out of calibration. Each feature in the Model 850 is chosen with an idea toward simplifying and speeding up the work of the serviceman. The color display showing one color at a time, the GUN KILLER, the DE-CONVERGENCE and the separate horizontal and vertical lines are innovations that are incorporated for this reason.

The Model 850 Provides:

1. DOTS—A dot pattern which may be used in static and dynamic convergence.
2. CROSS HATCH—A cross hatch pattern consisting of 10 vertical and 14 horizontal lines. This is very desirable for both horizontal and vertical linearity adjustments. It may also be used for vertical and horizontal convergence.
3. VERTICAL LINES—Vertical lines are used for horizontal linearity and vertical convergence adjustments.
4. HORIZONTAL LINES—Horizontal lines are used for vertical linearity and horizontal convergence.
5. COLOR—11 different colors are displayed, one at a time, for use in Hue and Demodulator adjustments. All colors are at 3.579545 mc and are crystal controlled. The necessary N.T.S.C. phase is developed by a precision delay line.
6. SYNCHRONIZATION SIGNALS—Crystal controlled pulses provide for horizontal and vertical synchronization.
7. VIDEO—Adjustable positive and negative going video signals are available at the front panel.
8. SOUND—A crystal controlled 4.5 mc sound carrier signal is provided.
9. DECONVERGENCE ASSEMBLY—An exclusive Deconvergence Assembly eliminates the necessity of having to mis-adjust the convergence controls in the set, to achieve a deconverged signal.
10. GUN KILLER—A GUN KILLER switch and its associated socket allows any one or more of the color tube guns to be turned off. This is particularly important in purity and convergence adjustments.
11. R.F.—A three position R.F. selector switch allows the operator to choose Channels 3, 4 or 5. All signals are fed into the receiver through the antenna terminals.
12. DEMODULATOR—A special demodulator testing circuit permits demodulator testing and alignment directly on the face of the color tube.
13. COLOR SYNC—A special COLOR SYNC test switch tests the set for low level color synchronization.
14. PATTERN DISPLAY STANDARD—An exclusive PATTERN DISPLAY STANDARD window in the front panel presents the pattern and color that should be seen on the television screen. This is an important guide to the serviceman in his adjustments.
15. MECHANICAL—A rugged mechanical assembly insures long life and maximum protection to the instrument. A cover with a mirror is added as a further convenience.
16. STAND-BY—A standby position on the power switch allows the instrument to remain heated without generating any external signals.

CONTROLS AND JACKS

What They Do and How They Work:

PATTERN SWITCH—This switch selects the type of pattern to be presented, namely:—DOTS, CROSSHATCH, VERTICAL LINES, HORIZONTAL LINES and COLOR.

COLOR SWITCH—Each color is presented one at a time with the proper N.T.S.C. phase angle as shown in Fig. 1. The colors are: Burst, Yellow, I, Red, R-Y, Magenta, Q, B-Y, Blue, Cyan and Green.

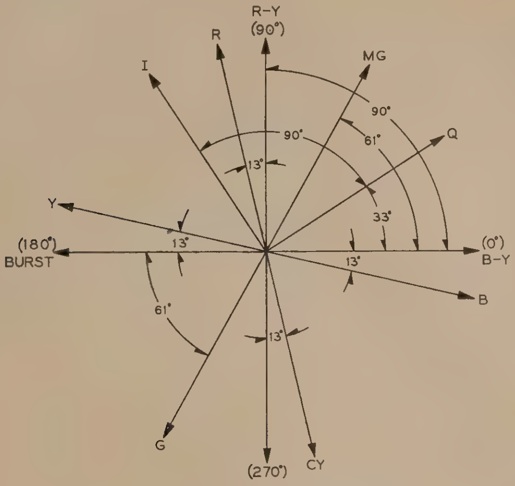


Fig. 1—N.T.S.C. Phase Relationships.

VIDEO POTENTIOMETER—Low impedance video signals are available from the Video Jack on the front panel, and are controlled by the VIDEO pot. In the center of its range, no signal is fed out. In its maximum counter clockwise position (+) a maximum positive going video signal is present. In the opposite position a maximum negative going signal is produced.

POWER SWITCH—In the first position the power is OFF. In the STANDBY position power is turned ON, but no signals are produced. In the ON position the instrument is operating. In the SOUND position the Model 850 is in operation and a 4.5 mc sound carrier is turned on. In the DECONVERGENCE position the instrument is operating normally, except that the SOUND is turned OFF and the DECONVERGENCE ASSEMBLY is operating.

GUN KILLER—

NORMAL	All the guns in the color tube are operating normally.
R	The red gun is on. Note: The letters on the panel indicate which gun or guns are turned on.
G	The green gun is on.
B	The blue gun is on.
RG	The red and green guns are on.
BG	The blue and green guns are on.
RB	The red and blue guns are on.

B DEMOD.	All the guns are on and the signal from the blue gri[illegible] the CRT is brought out to the DEMODULATOR jac[illegible] the front panel.
R DEMOD.	All the guns are on and the signal from the red grid is brought out to the DEMODULATOR jack.
G DEMOD.	All the guns are on and the signal from the green grid is brought out to the DEMODULATOR jack.

COLOR SYNC SWITCH—this switch is spring loaded and should always be in the NORMAL position, except when testing a color set to see if it will operate at low color levels. When testing for low color levels, the color signal is reduced, thereby testing the sets ability to hold color synchronization on weak signals.

HORIZONTAL JACK—A Sync signal is produced for the external horizontal synchronization of an oscilloscope.

R.F. SELECTOR—This is a three position switch located at the rear of the cabinet and selects Channels 3, 4 or 5. Select an open channel (one which is not used in your locality) and set the switch to that channel. This will eliminate the possibility of interference frequencies developing during the testing of a receiver. Once the correct channel is selected, the switch need not be switched to another channel. This is the reason why it was placed at the rear of the cabinet.

OPERATION.

R.F. PROBE—A red, a blue and a black lead eminates from the R.F. PROBE. When working on a standard television set, connect the red and blue alligator clips to the antenna input terminals. The antenna lead-in to the outside antenna should be removed from the set. Removing the antenna lead-in eliminates the possibility of unwanted signals causing interference. If the receiver has a coaxial line input, instead of a 300 ohm line, connect the black lead to the ground side of the coaxial cable and the red lead to the other terminal.

AGC ADJUSTMENT—The Model 850 output is set for normal signal areas. If the receiver AGC is set too high or too low it may be necessary to adjust its AGC for proper Model 850 reception. Incorrect AGC results in picture tearing, improper sync or contrast. Readjust AGC after completing installation. (See page 30 for final AGC ADJUSTMENT.)

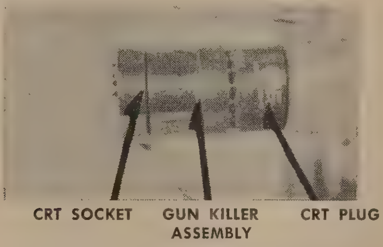


Fig. 2—Gun Killer and Demodulator Socket.

GUN KILLER & DEMODULATOR SOCKET (Used only with color tubes)—Turn the power off to the television set and remove the socket from the color tube. Connect the CRT socket to the GUN KILLER & DEMODULATOR PLUG and reinsert on to the CRT. Connect the black ground wire from the GUN KILLER & DEMODULATOR SOCKET to any convenient ground on the chassis of the receiver. The wires to the GUN KILLER AND DEMODULATOR SOCKET have been left loosely cabled in order to reduce capacity action between leads. You will note a similar construction going to the socket of the color tube. Make certain the leads from the GUN KILLER & DEMODULATOR SOCKET are not going over any high voltage circuits in the set. See Fig. 2.

DECONVERGENCE ASSEMBLY—Snap the DECONVERGENCE ASSEMBLY over the bakelite portion of the color tube base. Swivel the arm so that the front of the DECONVERGENCE ASSEMBLY prod is placed between the red and blue guns as shown in Fig. 3.

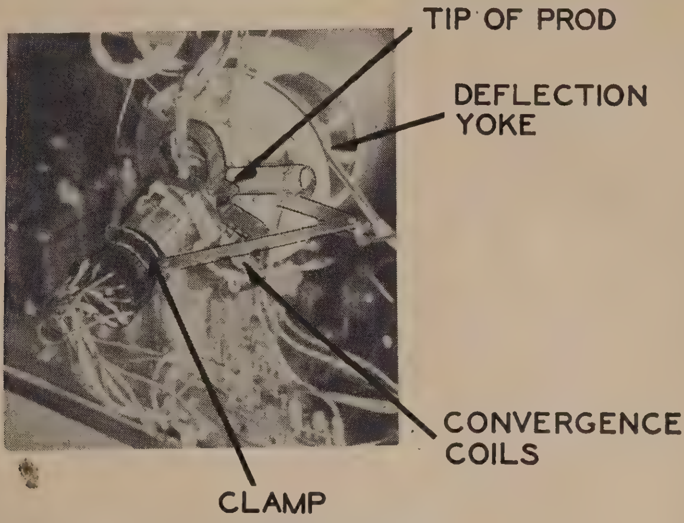


Fig. 3—Deconvergence Assembly.

GENERAL OPERATION

Turn the AC power ON to both the Model 850 and the color TV set. It is suggested that you allow the Model 850 to have at least a 15 minute warm-up period, this may be accomplished without any loss of time by turning ON the instrument as soon as you enter the home.

Rotate the POWER switch to the ON position. Rotate the PATTERN switch to the DOTS position. Rotate the GUN KILLER switch to the NORMAL position. Tune the receiver to the open R.F. channel you selected at the rear of the Model 850 cabinet. Turn the contrast control on the receiver to its maximum position and decrease the brightness control until the dots are just barely seen. It may be necessary to adjust the fine tuning of the receiver to bring the dots in properly. If the brightness control is advanced too far on the television set, you will note that background lines appear in the DOTS position. Always decrease the brightness until the background can no longer be seen. If too much brightness is used the dot size will tend to increase due to blooming of the CRT. Test in a darkened room if possible. Note that you see the dot pattern in the PATTERN DISPLAY STANDARD window. If you now rotate the GUN KILLER switch, the color on the face of the color tube changes in accordance with the position selected. Correspondingly, the PATTERN DISPLAY STANDARD window only shows the correct display.

Switching now to the CROSSHATCH position of the PATTERN switch, the CROSSHATCH pattern should appear both in the PATTERN DISPLAY STANDARD window and on the screen. If the horizontal and vertical lines are not of equal brightness, adjust the fine tuning of the receiver until they are. Since the bandpass characteristics of some receivers changes with the setting of the contrast control, readjust the contrast setting, if necessary, to produce equal brightness vertical and horizontal lines. The brightness might have to be readjusted af[illegible] changing the contrast setting.

Switching now to VERTICAL lines, and then to HORIZONTAL lines, will show each one of these displays individually.

Rotating the PATTERN switch to the COLOR position should result in a color being displayed on the screen of the tube as shown in Fig. 4.

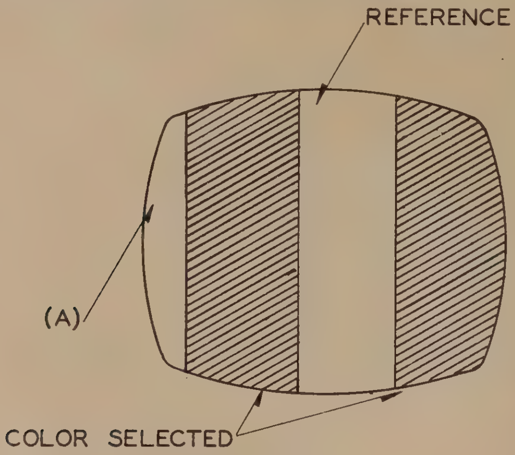


Fig. 4—Color Display.

Set the COLOR switch to some known color, such as RED, and adjust the HUE control on the front of the television set until a RED color appears on the face of the tube. Note that the color occupies about the first third of the tube and then the last third of the tube. The intervening area is what we call our REFERENCE, and will be discussed later on in DEMODULATOR ALIGNMENT. The small section, designated as (a) in Fig. 4, may or may not be seen depending on the setting of the horizontal width and horizontal hold controls.

Adjust the fine tuning of the receiver until the color comes in and then starts to loose color or color sync. Back tracking from the position where the color is no longer proper is usually the correctly tuned position.

The COLOR SYNC switch should be in the NORMAL position. The GUN KILLER switch should also be in the NORMAL position. The brightness control on the receiver should be brought up until the REFERENCE section of the color presentation can be seen. Keep the chroma level control to as low a setting as possible consistent with good color presentation. In general, the color levels should be kept as low as possible, the set should be viewed in a darkened room and the brightness control should be kept to a comparatively low level. Adjust brightness if necessary to produce the proper saturation of the color—the hue is automatically determined by the phase angle of the signal from the Model 850. The REFERENCE section color is not important.

Rotating the COLOR switch should produce all the colors as seen in the pattern window. YELLOW is a somewhat difficult color to produce on a color TV set and has shades of green in it. It might be necessary to readjust the Chroma level and the Brightness control to properly bring in particular colors.

GUN KILLER. Switch now to some pattern such as CROSSHATCH. In the NORMAL position the pattern will be black and white. If you now switch the

GUN KILLER to R, the pattern, of course, will be a crosshatch in red. Rotating the GUN KILLER to its various other positions will give you a green, blue, yellow, cyan or magenta color. In the DEMOD. (demodulator) position the black and white pattern will reappear.

DECONVERGENCE. If you now switch to the DOTS position of the PATTERN switch, the DOT pattern will appear. Rotating the POWER switch to the DECONVERGE position will separate the white dots into red, green and blue dot trios. The contrast control should be at maximum and the brightness control on the television set should be set as low as possible. You will note the action of the DECONVERGENCE ASSEMBLY by switching back and forth between the DECONVERGE position and the ON position with the POWER switch. Adjust fine tuning for proper dots if necessary.

If the red, blue and green dots do not separate far enough (approximately 1/16″ or 1/8″ apart) change the position of the DECONVERGENCE ASSEMBLY. The closer it is pressed toward the neck of the tube, the farther apart the dots will separate. As it is rotated around the neck of the tube it will have more effect on one color dot than on the other. By using the GUN KILLER switch you may cutoff one or more of the color guns as desired.

Switch to VERTICAL LINES and rotate the POWER switch to the DECONVERGE position, you will note that you have parallel lines of red, green and blue. Each of these lines should be parallel from the top down to the bottom. If they are not parallel, this represents receiver misconvergence. Rotating the GUN KILLER to the RB position, as an example, kills the green gun. If the red and blue lines are not completely parallel vertically, a dynamic convergence problem is indicated.

As an example, if the lines were apart and parallel through the first ¾ of the screen, starting from the top and going toward the bottom, and tended to come together at the bottom, the problem would be bottom vertical convergence. You would then go to the control which affects bottom vertical convergence on the TV set and adjust it to the position which will make the lines as parallel as possible.

Switch to HORIZONTAL LINES and repeat the same procedure as with VERTICAL LINES.

TUNING. Turn the PATTERN switch to COLOR and get a color pattern on the screen of the color tube. Make sure the GUN KILLER is in NORMAL position. Switch to SOUND and you will see the SOUND beat (920 kc) mix in the picture. Rotate the fine tuning of the receiver until this beat is noticeable and then back track until the beat just starts to disappear. It need not completely disappear. You are tuned in properly at this point. At all times when viewing color make sure the center section can be seen clearly and the brightness is properly adjusted. The 920KC sound beat may not be noticeable on some receivers. In this case tune to the position where the best color reception is achieved for all colors.

SET-UP PROCEDURE

DEGAUSSING—Before any adjustments are made it is most important that the color tube be demagnetized. This is accomplished by using a degaussing coil. The coil should be plugged into the AC line and then brought over toward the face of the tube and moved slowing around the front section of the tube. It is also a good idea to demagnetize the chassis, or chassis', if any, around the front edge of the tube. After about 60 seconds of the DEGAUSSING, move slowly away from the tube until you are at least 8 or 10 feet away from it and then turn off the degaussing coil. If you are wearing a watch, likewise move it away from the degaussing coil before turning off the coil.

LINEARITY ADJUSTMENTS—Develop a crosshatch pattern on the television set by switching the PATTERN selector to CROSSHATCH. Check the horizontal and vertical linearity of the receiver and make what ever adjustments are necessary. If the focus needs adjustment, make this adjustment also. Since the width, height and linearity adjustments can affect the convergence of [illegible] receiver, these should be completed before convergence is started.

INITIAL CONVERGENCE—The receiver should be placed in the location and position in which it will be operated. Set the PATTERN switch of the Model 850 to the DOTS position. Turn the contrast control up to maximum and reduce the brightness control to the point where the dots are just visible on the receiver.

Adjust the red, green and blue magnets shown in Fig. 5, and the lateral blue magnet to obtain convergence of the dots in the center of the kinescope screen.

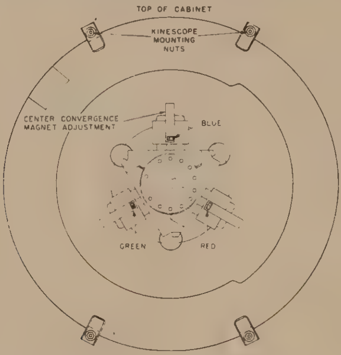


Fig. 5—Center Convergence Magnets.

The motion of each dot when its magnet is adjusted is shown in Fig. 6A.

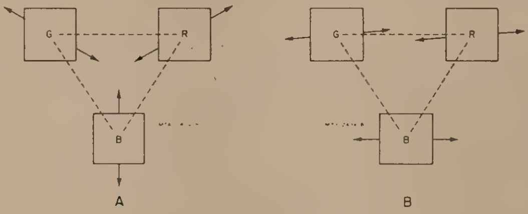


Fig. 6—Dot Movement Pattern.

Fig. 6B shows the effect of the blue lateral magnet on the three dots. If a greater range of adjustment is required, the magnet may be slid out of its plastic holder and rotated 180° and replaced back in its holder. Make sure that it is properly clipped in place.

COLOR PURITY ADJUSTMENTS—Rotate the PATTERN selector to the COLOR position. Turn the contrast control of the receiver down to minimum and turn the chroma control of the receiver to minimum. Increase the brightness control until the raster can be seen clearly. The raster should be clear of any signal. If not, disable the receiver by rotating the channel selector between channels, or remove one of the R.F. tubes.

Rotate the GUN KILLER switch to the R position. A red raster should appear only. (Note:—This is the one case where the picture and the PATTERN DISPLAY STANDARD window will not be the same as seen on the screen because [illegible] receiver chroma control is turned down.) Rotate the purity magnet around the [illegible]k of the kinescope and at the same time adjust the tabs on the magnet to produce a uniform red screen area at the center of the kinescope, see Fig. 7.

It may now be necessary to move the yoke forward or back for best overall red screen appearance.

Switch the GUN KILLER back to the NORMAL position and, if you have a magnifying glass or a low power microscope, examine the dots. If any one of the three colors is not visible, adjust the setting of the "kine bias" control.

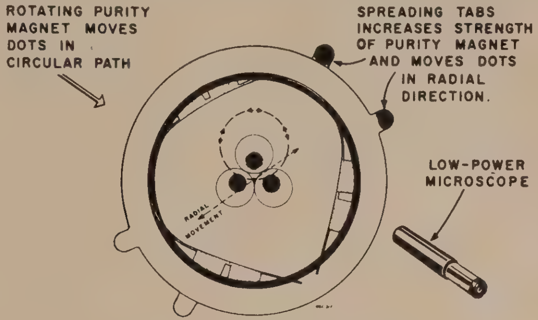

ROTATING PURITY MAGNET MOVES DOTS IN CIRCULAR PATH
SPREADING TABS INCREASES STRENGTH OF PURITY MAGNET AND MOVES DOTS IN RADIAL DIRECTION.
LOW-POWER MICROSCOPE
RADIAL MOVEMENT

Fig. 7—Center Landing Adjustments.

Switch the GUN KILLER to the G position and observe the green screen and then to the B position and observe the blue screen. If the red is properly adjusted, the green and blue screens normally come in. Make sure the yoke clamp is secure.

KINESCOPE TEMPERATURE ADJUSTMENTS & BLACK & WHITE TRACKING—If a kinescope temperature adjustment is required, it is suggested that you follow the manufacturer's procedures. The RCA & Zenith procedures are incorporated later on in this book.

CENTER CONVERGENCE RECHECK—Switch the PATTERN selector back to DOTS, the GUN KILLER back to NORMAL. Set the contrast control of the receiver to maximum and reduce the brightness until the dots can just be seen. Recheck the convergence in the center of the picture and, if any adjustment is necessary, repeat the procedure for dot convergence previously employed. If readjustment is required, you might again cross check the color purity adjustments.

GENERAL DYNAMIC CONVERGENCE

VERTICAL CONVERGENCE. The vertical convergence adjustments should be performed before making horizontal convergence adjustments. Set the PATTERN switch to VERTICAL lines, and adjust the tuning, brightness and contrast control until thin clear vertical lines are seen. This is normally with maximum contrast and a low brightness setting. Switch GUN KILLER to the RG position which shorts out the blue gun. Turn the POWER switch to DECONVERGE position which separates the red and green lines. The two lines should be parallel to each other from the top to the bottom of the screen.

Adjust the red vertical convergence amplitude and vertical convergence phase controls to produce a straight red line, if necessary.

Adjust the green vertical convergence amplitude and vertical convergence phase controls to obtain a straight green line parallel with the red line, if necessary.

Repeat the preceeding two steps until both lines are uniform with respect [illegible] each other.

HORIZONTAL. Switch to the HORIZONTAL position of the PATTERN switch. Observe the horizontal lines in the center. The red horizontal convergence amplitude and horizontal convergence phase controls are adjusted for a horizontal red line.

Adjust the green horizontal convergence amplitude and horizontal convergence phase controls to form a horizontal green line parallel with the red line, if necessary.

Switch the GUN KILLER to the BR position which allows the blue and red guns to operate. The green gun, therefore, is shorted out. If the lines do not separate, rotate the position of the Deconvergence Assembly.

Switch the PATTERN switch to VERTICAL LINES. Adjust the blue vertical convergence amplitude and vertical convergence phase controls until the blue lines are equally spaced with the red lines, and are parallel.

Switch to HORIZONTAL LINES. Adjust the blue horizontal convergence amplitude and horizontal convergence phase controls until the blue lines are equally parallel with the red lines.

Switch from the DECONVERGE position and rotate the GUN KILLER switch to the NORMAL position. White lines should appear.

The RCA Set-Up Procedure has been incorporated in this book for your convenience.

COMPLETE SET-UP PROCEDURE

(Courtesy RCA Victor)

Initial Adjustments

Adjust the receiver for a black and white picture. The receiver should be placed in the location and position in which it will be operated.

Check the horizontal oscillator and the conventional adjustments of height, vertical linearity, focus, and electrical centering. Make adjustments where necessary.

Preliminary Convergence Adjustment

The Model 850 generator should be connected to the receiver to provide a dot pattern on the kinescope for making convergence adjustments.

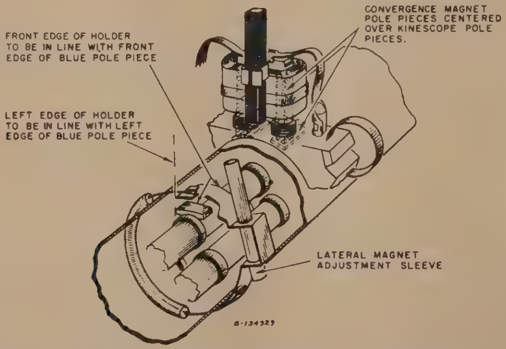

CONVERGENCE MAGNET POLE PIECES CENTERED OVER KINESCOPE POLE PIECES.
FRONT EDGE OF HOLDER TO BE IN LINE WITH FRONT EDGE OF BLUE POLE PIECE
LEFT EDGE OF HOLDER TO BE IN LINE WITH LEFT EDGE OF BLUE POLE PIECE
LATERAL MAGNET ADJUSTMENT SLEEVE
8-134329

Fig. 8—Location of Convergence and Lateral Beam Magnets.

Adjust the red, green, and blue magnets (shown in Fig. 5), and the lateral magnet to attain convergence of the dots in the center of the kinescope screen. The direction of movement of the dots, using the magnets, is shown in Fig. 6A. Lateral movement of the dots is accomplished by adjustment of the lateral magnet, see Fig. 8. Red and green movement is opposite the blue, with the dots moving as shown in Fig. 6B.

The magnets may be reversed to produce a greater range of adjustments. To do this slide the plastic magnet holder out of its metal clip and rotate the holder 180°. Replace the holder in the clip making sure that the magnet is reinserted in the clip.

Keep the receiver in focus when making the above adjustment. Set the generator to "STAND BY" position.

Color Purity Adjustments

The kinescope and associated components should be subjected to a strong demagnetizing field before any purity adjustments are made. Use a demagnetizing coil and slowly move the coil around the kinescope and around the sides and front of the receiver; then slowly withdraw the coil at least 10 feet from the receiver before de-energizing it.

Set the red tabs on the purity magnet together. Refer to Figures 7 and 9.

Loosen the screw on the yoke clamp and slide the yoke as far to the rear as possible. See Figure 9.

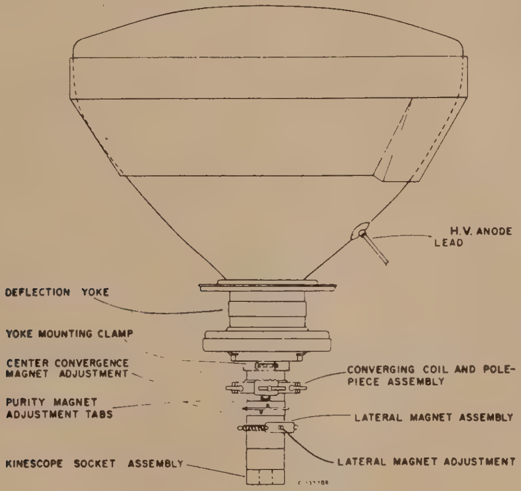

H.V. ANODE LEAD
DEFLECTION YOKE
YOKE MOUNTING CLAMP
CENTER CONVERGENCE MAGNET ADJUSTMENT
CONVERGING COIL AND POLE-PIECE ASSEMBLY
PURITY MAGNET ADJUSTMENT TABS
LATERAL MAGNET ASSEMBLY
KINESCOPE SOCKET ASSEMBLY
LATERAL MAGNET ADJUSTMENT

Fig. 9—Kinescope Adjustments and Components.

Shunt the blue and green kinescope grids to ground through individual 100,000 ohm resistors. (Instead of shunting the grids to ground, rotate the Gun Killer switch to R).

Rotate the purity magnet around the neck of the kinescope and at the same time adjust the tabs on the magnet to produce a uniform red screen area at the center of the kinescope.

Then, to obtain proper edge landing, move the yoke forward and adjust for best overall red screen.

For optimum purity, observe beam landing using a low-power microscope, and check all three screens (see Figure 7 and 10). If any one of the three colors cannot be seen while observing beam landing advance the setting of the associated screen control. If any one of the three colors is still not visible, adjust the setting of the "Kine Bias" control in the clockwise direction.

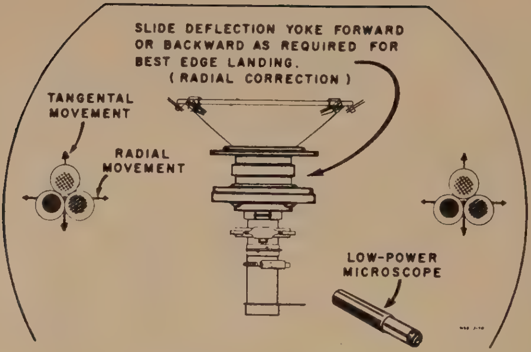

SLIDE DEFLECTION YOKE FORWARD OR BACKWARD AS REQUIRED FOR BEST EDGE LANDING.
(RADIAL CORRECTION)
TANGENTAL MOVEMENT
RADIAL MOVEMENT
LOW-POWER MICROSCOPE

Fig. 10—Edge Landing Adjustments.

Kinescope Temperature Adjustments

Turn the kinescope bias and screen controls fully counterclockwise. Refer to Figure 11. Move the "Normal Service" switch on the rear apron to the "Service" position.

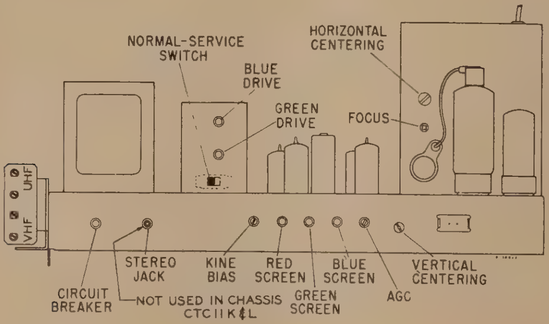


Fig. 11—Rear Chassis Adjustments.

Advance the screen controls so that each control just produces a horizontal line on the kinescope.

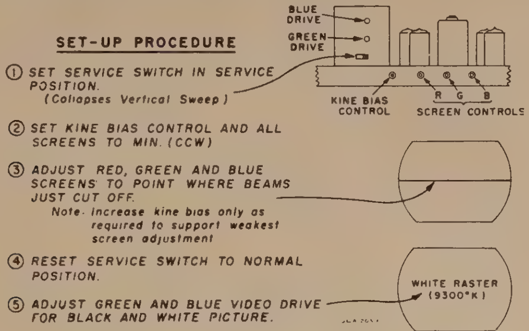
Note: When one or more of the controls fail to produce a line, the kinescope bias control must be advanced clockwise. After the bias control has been advanced to make the extinguished screen just light, the other screen controls must be adjusted to just light the screen in each case.

Return the "Normal-Service" switch to "Normal."

Alternately adjust the blue and green video drive controls to produce a normal black and white picture (9300° Kelvin).

Check the picture from highlights to lowlights at all brightness levels for proper tracking. If the screen controls were accurately adjusted as outlined above, proper tracking at all brightness levels should be obtained.

An alternate method for adjusting kinescope temperature that sometimes provides greater accuracy involves just extinguishing the horizontal line after lighting it as explained previously. See Figure 12.



SET-UP PROCEDURE

① SET SERVICE SWITCH IN SERVICE POSITION.
(Collapses Vertical Sweep)

② SET KINE BIAS CONTROL AND ALL SCREENS TO MIN. (CCW)

③ ADJUST RED, GREEN AND BLUE SCREENS TO POINT WHERE BEAMS JUST CUT OFF.
Note. Increase kine bias only as required to support weakest screen adjustment

④ RESET SERVICE SWITCH TO NORMAL POSITION.

⑤ ADJUST GREEN AND BLUE VIDEO DRIVE FOR BLACK AND WHITE PICTURE.

Fig. 12—Alternate Method of Kinescope Temperature Setup.

Center Convergence Adjustments

A dot pattern should be used to set center convergence. Center convergence is performed with the three magnet adjustments on the convergence coil assembly around the kinescope neck and with the lateral magnet also on the kinescope neck. Refer to Figures 5 and 9.

Recheck the dot pattern for white dots in the center of the screen. If necessary, readjust to produce this condition, following the procedure under "Preliminary Convergence Adjustment".

For optimum performance recheck the screen purity. If adjustment is required refer to "Color Purity Adjustments." After correcting for purity error, recheck the center convergence.

Vertical Convergence Adjustments

Note: In following the procedure on vertical convergence adjustment, instances may be encountered whereby adjustment of the vertical tilt controls will not produce optimum convergence. If this condition exists, the range of the tilt controls may be broadened by changing the ground jumper connection of the tilt winding on vertical output transformer from the tap (black-green wire) to the end of the winding (black-red wire).

Changing the connections in this manner will provide all the required vertical tilt range for optimum convergence.

Vertical convergence adjustments should be performed before making horizontal convergence adjustments. Turn the generator to vertical lines. Switch GUN KILLER to the RG position.

The convergence board assembly is designed to permit adjustments to be made from the front of the receiver. Loosen the two screws holding the board and slide the bracket to the left and remove. Fasten the bracket to the two screws provided on the top rear rail of the cabinet with the controls facing to the front. Slots are provided in the bottom of the bracket for mounting in this position.

Referring to the vertical line at the center of the screen, adjust the Vertical R-G Master Amplitude control to converge the center line at the bottom, refer to Figures 13A and 14. Adjust the Vertical R-G Master Tilt control to converge [illegible] center line at the top of the screen. Touch up both adjustments for best conv[illegible]ence along the entire center vertical line.

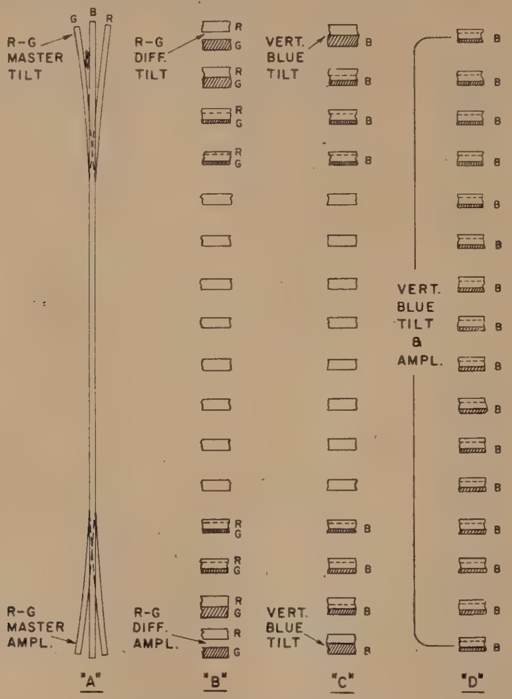


Fig. 13—Vertical Convergence Pattern.

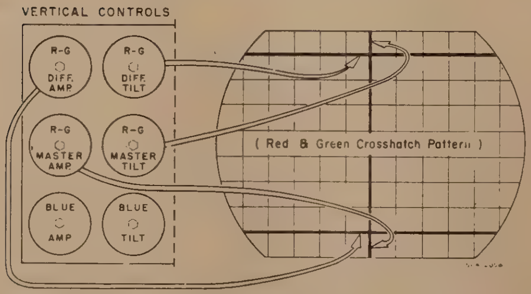


Fig. 14—Use of Vertical Master and Differential Controls.

Turn the generator to horizontal lines. Referring to the center line of the screen, converge the horizontal line at the bottom of the screen with the Vertical R-G Differential Amplitude control. Adjust the Vertical R-G Differential Tilt control to converge the top horizontal line at the center of the screen, refer to [illegible]ures 13-B and 14. Touch up both adjustments for best convergence of all lines [illegible] the vertical center line of the screen.

Switch to DOTS and CONVERGE the center area of the screen with the convergence magnets on the kinescope neck. Switch the generator back to HORIZONTAL LINES, the GUN KILLER to NORMAL.

Advance the Vertical Blue Amplitude control to produce displacement of the lines at the top and bottom of the screen at the center line. Adjust the Vertical Blue Tilt control to produce equal displacement of the lines at both top and bottom of the screen at the center line. Refer to Fig. 13-C. Adjust the Vertical Blue Amplitude and Tilt controls to produce equal displacement of all lines from top to bottom of the screen along the center line, see Fig. 13-D.

Switch the generator to crosshatch and again converge the center of the screen. Retouch the Vertical Blue Tilt and Amplitude controls for best convergence along the vertical center of the screen.

HORIZONTAL CONVERGENCE ADJUSTMENTS

Turn the generator to produce a crosshatch pattern. Recheck for good center convergence and readjust center convergence magnets if required. Refer to Fig. 15 during the horizontal convergence adjustments.

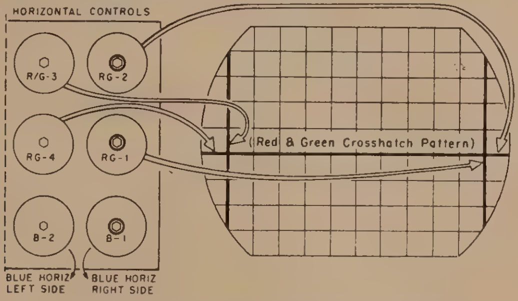


Fig. 15—Use of Horizontal R/G Convergence Controls.

Adjust coil B-1 to make the blue line at the right center of the kinescope a straight line.

Adjust control B-2 for a straight blue line from the center to the left side of the kinescope.

Note: To facilitate making horizontal convergence adjustments it is recommended that the GUN KILLER be in the RG position when making green and red adjustments.

Adjust coil RG-1 to make vertical lines at the right side converge.

Adjust coil RG-2 to make horizontal red and green lines at the right side converge. Readjust coil B-1 (GUN KILLER to NORMAL), to make the blue line at the right center fall on the converged red and green lines. Retouch RG-1 for convergence of vertical lines at the right side.

GUN KILLER to RG and adjust control RG-3 to make vertical lines at the left side converge.

Adjust control RG-4 to make the red and green horizontal lines at the left side of the screen converge.

After adjusting RG-4 repeat adjustment of RG-3 to compensate for any interaction. Readjust control B-2 (GUN KILLER to NORMAL) to make the blue line at the left center fall on the converged red and green lines. The pattern sho[illegible] now show proper convergence on all areas of the screen.

After completion of vertical and horizontal convergence adjustments, check and if necessary repeat "COLOR TEMPERATURE ADJUSTMENTS".

COMPLETE SET-UP PROCEDURE

ZENITH—29JC20 and 29JC20Q

(Courtesy Zenith Radio Corp.)

The following section is the Zenith Set-Up Procedure and has been incorporated for your convenience.

Focus

The focus adjustment (variable inductance L39) is in series with a winding on horizontal output transformer T10 and the plate of the Focus Rectifier tube. It is physically located at the rear of the high voltage cage. When adjusting for proper focus, Brightness and Contrast controls should be set at approximately viewing level.

Delay Line Termination

The Delay Line Termination is a factory adjustment which should require resetting only if the Delay Line or associated terminating component(s) are replaced.

If adjustment is required, apply a steady RF crosshatch pattern to the receiver antenna terminals or tune receiver to steady test pattern. Set Contrast to maximum and Brightness control for reasonable brightness without "blooming." Adjust for minimum reflections on delay line (reflections will appear similar to video "ringing" caused by excessive high frequency response).

Color Purity

The first step toward adjusting a color receiver for good purity is to demagnetize (degauss) the picture tube. If the picture tube shadow mask has become slightly magnetized, good purity may be difficult to achieve.

Demagnetizing the Color Picture Tube

The demagnetizing procedure may be performed with the receiver either in or out of the cabinet. To demagnetize the picture tube shadow mask, a degaussing coil is required, and procedure is as follows:

1. Place the receiver (either ON or OFF) in the same position as for viewing. Position the degaussing coil in a parallel plane against the face of the picture tube. Energize the coil.
2. Slowly rotate the coil around the face of the picture tube for approximately one full minute. If the receiver is turned ON during the degaussing procedure, the raster will exhibit a "swirling" rainbow type pattern. Slowly withdraw the coil while continuing to rotate it parallel to the picture tube face plate.
3. Withdraw to a distance of 10 ft. or more and deenergize coil. If impossible to back off 10 ft., this distance can be simulated by withdrawing the coil to a distance of about 5 ft. and then gradually reducing the coil supply voltage to zero by use of a variac or similar device.

[illegible]rity Adjustment Procedure

To adjust for purity, perform the following adjustments:

1. Converge pattern at center of screen by sliding the permanent magnet adjusting sleeves in or out. See Figure 16. If range is inadequate, remove sleeve, rotate 180° and reinsert.

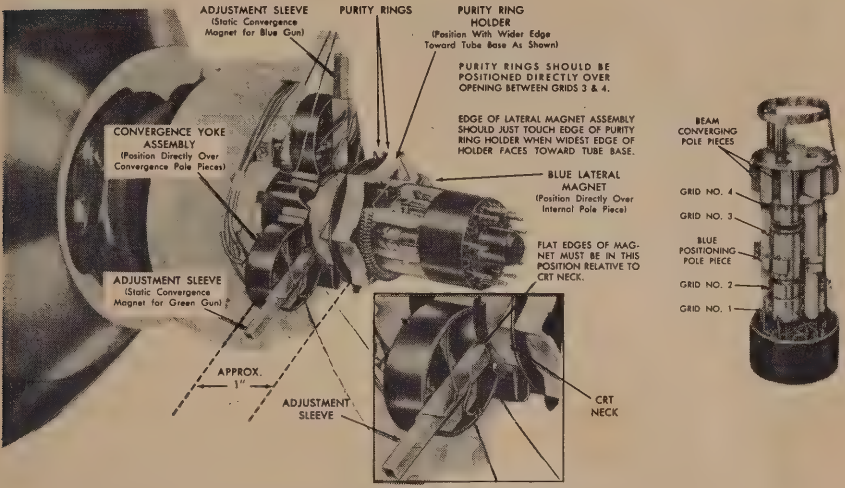

ADJUSTMENT SLEEVE
(Static Convergence Magnet for Blue Gun)
PURITY RINGS
PURITY RING HOLDER
(Position With Wider Edge Toward Tube Base As Shown)
PURITY RINGS SHOULD BE POSITIONED DIRECTLY OVER OPENING BETWEEN GRIDS 3 & 4.
EDGE OF LATERAL MAGNET ASSEMBLY SHOULD JUST TOUCH EDGE OF PURITY RING HOLDER WHEN WIDEST EDGE OF HOLDER FACES TOWARD TUBE BASE.
CONVERGENCE YOKE ASSEMBLY
(Position Directly Over Convergence Pole Pieces)
BLUE LATERAL MAGNET
(Position Directly Over Internal Pole Piece)
FLAT EDGES OF MAGNET MUST BE IN THIS POSITION RELATIVE TO CRT NECK.
ADJUSTMENT SLEEVE
(Static Convergence Magnet for Green Gun)
APPROX. 1"
ADJUSTMENT SLEEVE
CRT NECK
BEAM CONVERGING POLE PIECES
GRID NO. 4
GRID NO. 3
BLUE POSITIONING POLE PIECE
GRID NO. 2
GRID NO. 1

Fig. 16—Rear View of Picture Tube, Showing Correct Positioning of Neck Components.

2. Place the receiver in the same position as for viewing. With receiver ON, set the Contrast control to minimum. Brightness control to near maximum.
3. Disable the blue and green picture tube guns by turning their Screen adjustments to minimum (counter-clockwise). (Note: Gun Killer could be used here.) See Figure 17.

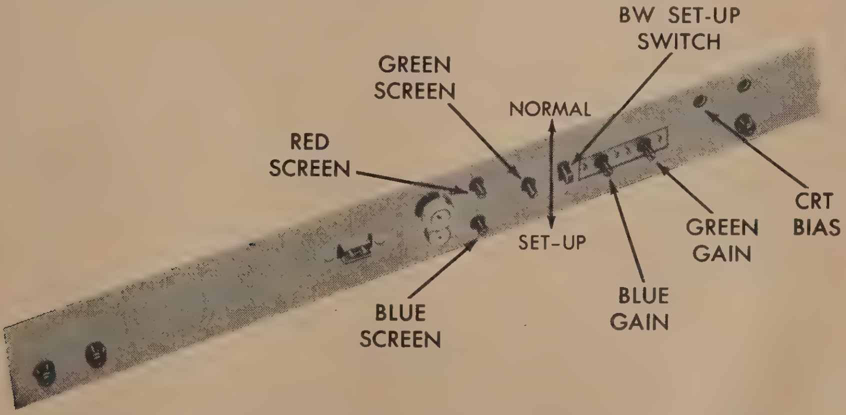


Fig. 17—Rear View of Chassis, Showing Location of Black and White Tracking Adjustments.

4. Rotate each Purity Ring (spreading the tabs apart) until the purest red ra[illegible] is obtained over all of the screen area. If a pure red raster cannot be obta[illegible] over all of the screen area, move the deflection yoke forward or backward to improve overall purity until the entire screen is pure red. Purity in the central area of the raster is achieved by the Purity Ring adjustment; outer area purity is achieved by deflection yoke positioning.
5. Check the green raster by turning the Red Screen adjustment to minimum and turning up the Green Screen adjustment. The raster should appear green over the entire screen area. GUN KILLER may be used here.
6. Check the blue raster by turning the Green Screen adjustment to minimum and turning up the Blue Screen adjustment. The raster should appear uniformly blue over the entire screen area. GUN KILLER may be used here.
7. Perform black and white tracking.

Black & White Tracking

If a color set is to have good black and white tracking, it must produce black and white pictures within the normal usable range of both the Contrast and Brightness controls. At the extreme settings of the Brightness and Contrast controls, blooming may occur and off-colors may exist even though the receiver may have good black and white tracking within the normal usable range. The three Screen Grid adjustments, the B and G Gain, and CRT Bias adjustments, plus the Brightness and Contrast controls, are used for adjusting black and white tracking. During this procedure, the voltages on the cathodes, control grids, and screen grids of the picture tube guns are adjusted to produce black and white pictures throughout the usable range of the Brightness and Contrast controls.

To adjust, tune in a monochrome picture that displays an adequate range of light levels, light and grey objects, dark objects, etc. Set the Brightness and Contrast controls for a normal picture. Do not bloom the picture.

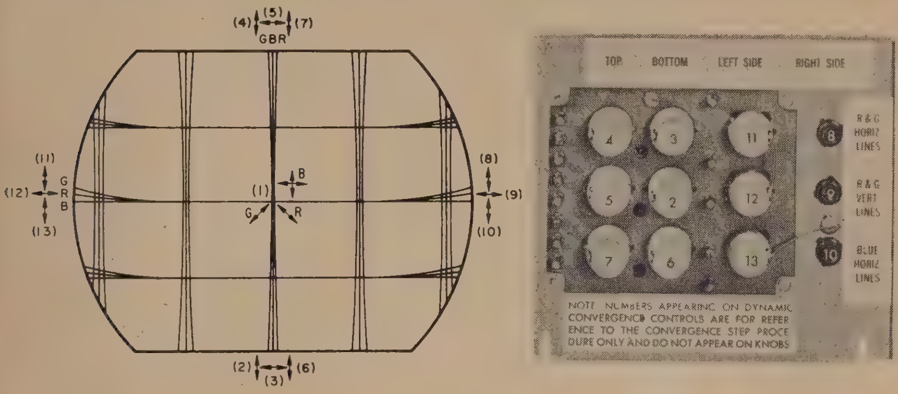
1. Set the CRT Bias and the three Screen adjustments to minimum (fully counter clockwise.) See Figure 17.
2. Set the BW Switch to Set-Up position. In this position the vertical sweep is removed to facilitate adjustments.
3. Advance each Screen adjustment to just produce a white horizontal line of low brightness through the center of the screen. If one or more of the Screen adjustments fail to produce a line, leave the particular Screen setting(s) at maximum. Advance the CRT Bias setting to just produce a line for that particular Screen adjustment(s).
4. Return the BW Switch to "Normal" position.
5. Alternately adjust the Blue and Green Gain adjustments to produce a normal black and white picture.

   NOTE: If difficulty is encountered in obtaining good black and white tracking, refer to manufacturers' manual.

Check overall black and white tracking throughout the normal Brightness and Contrast range. Accuracy of Screen adjustments is important.

Tune in a CROSSHATCH pattern. Of the twelve adjustments on the dynamic convergence panel, three are used for convergence at the top of the raster; three for the bottom of the raster; three for the left side of the raster; and three for the right side of the raster.

Converge pattern at center of screen by adjusting the blue lateral magnet and sliding the permanent magnet adjusting sleeves in or out. If range is inadequate, remove sleeve, rotate 180° and reinsert. See Fig. 18.



NOTE: NUMBERS APPEARING ON DYNAMIC CONVERGENCE CONTROLS ARE FOR REFERENCE TO THE CONVERGENCE STEP PROCEDURE ONLY AND DO NOT APPEAR ON KNOBS

Fig. 18.

2. Merge the red and green horizontal lines at bottom center of pattern using R&G Horiz. Lines, bottom adjustment.

3. Merge the red and green vertical lines at bottom center of pattern using R&G Vert. Lines, bottom adjustment.

4. Merge the red and green horizontal lines at top center of pattern using R&G Horiz. Lines, top adjustment.

5. Merge the red and green vertical lines at top center of pattern using R&G Vert. Lines, top adjustment.

   Repeat adjustments 1 through 5 to achieve best vertical red-green convergence from top center to bottom center.

6. Merge the blue horizontal line with red and green lines at bottom center of pattern using Blue Horiz. Lines, bottom adjustment.

7. Merge the blue horizontal line with red and green lines at top center of pattern using Blue Horiz. Lines, top adjustment.

   Repeat adjustments 6 and 7 to achieve convergence of blue line with red and green lines from top center to bottom center. If necessary, repeat step 1 to converge the blue beam with the read and green beams.

8. Merge the red and green horizontal lines at right center of pattern using R&G Horiz. Lines, right side adjustment.

9. Merge the red and green vertical lines at right center of pattern using R&G Vert. Lines, right side adjustment.

10. Merge the blue horizontal line with the red and green lines at right center of pattern using Blue Horiz. Lines, right side adjustment.

11. Merge the red and green horizontal lines at left center of pattern using R&G Horiz. Lines, left side adjustment.

12. Merge the red and green vertical lines at left center of pattern using R&G Vert Lines, left side adjustment.

13. Merge the blue horizontal line with red and green lines at left center of patte[illegible] using Blue Horiz. Lines, left side adjustment.

If necessary, repeat adjustments 8 through 13 to achieve best horizontal convergence from left side center to right side center. Although the degree to which color receivers can be converged will vary, good convergence should be achieved within an area out to approximately 2″ from the edges, top and bottom of the raster. Some misconvergence may exist at extreme edges of the raster which is normal and undetected at normal viewing distance.

GENERAL DEMODULATOR ALIGNMENT (WITHOUT AN OSCILLOSCOPE)

Set the PATTERN switch to COLOR, the COLOR switch to R-Y. With the GUN KILLER switch in the normal position, a red pattern should be noted on the screen of the tube. Turn the receiver contrast control down to minimum and increase the brightness if necessary so that the center bar can be seen clearly. Set the Tint or Hue control of the receiver to its middle position. Make certain the set is tuned in properly and, if need be, feed in sound and rotate the fine tuning of the receiver until the set goes out of synchronization and then back track until the 920 kc beat starts to decrease. Advance the Chroma control until a clear red picture is seen.

Rotate the GUN KILLER switch to the B (blue) position.

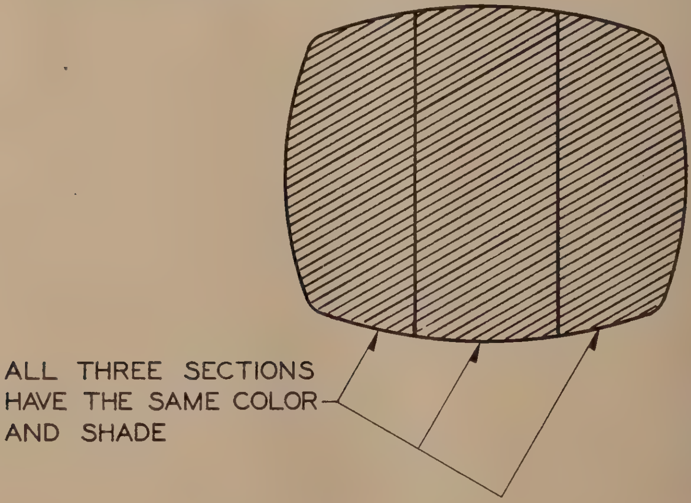


Fig. 19.

Adjust the Hue control until the same approximate shade of color exists in the three sections of the screen. In other words, the first section should look similar to the second section, and should look similar to the third. This refers to both the amplitude and the shade of the color. Keep the Chroma amplitude control to as low a level as possible while making certain, of course, that the Hue control can still vary the picture.

Rotate the COLOR switch to the B-Y position and the GUN KILLER switch the R (red) position. If the demondulators are correctly set the three sections of the screen should have approximately the same shade of red. If the three sections of color were the same shade of blue in the first case and the same shade of red in the second test, the demodulators are properly aligned.

In essence what we just did was as follows:—In the first case we fed an R-Y signal in and then turned off the red and green guns thereby only allowing the blue gun to remain on. When R-Y is fed into the receiver no signal should be seen on the blue grid. The pattern generated by the Model 850 consists of a color section, a space without color and another color section. When you adjusted the Hue control so that the three sections had the same shade and intensity, you were adjusting the phase angle so that no signal would be present on the blue grid. This meant that the blue demodulator was properly set for an R-Y signal. (No blue signal when red is transmitted.)

When the color switch was switched to B-Y and the GUN KILLER was moved to the R position, a B-Y signal was fed in and no color should appear at the red grid. If these two conditions are satisfied, it shows that the demodulators are properly set.

If the demodulators are considerably out of phase with each other, (this is not a usual condition) insert an alignment tool into the demodulators and adjust them.

With the Tint or Hue control in its mid position, the set should be pretty close to where R-Y and B-Y colors come in properly. If it is considerably apart, the phase transformer should be adjusted.

DEMODULATOR ALIGNMENT (USING AN OSCILLOSCOPE)

The procedure to follow in aligning a color receiver with an oscilloscope is quite similar to that employed in the alignment without one. The basic difference is that instead of viewing the color on the face of the tube it is observed on an oscilloscope.

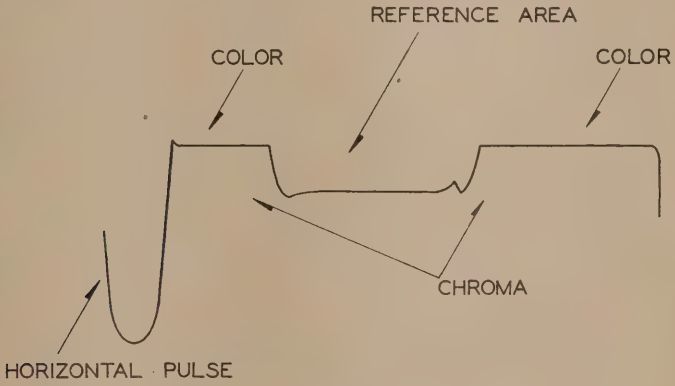


Fig. 20

Insert a lead from the vertical of the oscilloscope into the DEMODULATOR jack. Connect the ground lead to the GROUND terminal of the Model 850. Connect the lead from the external horizontal synchronizing jack of the oscilloscope to the HORIZONTAL jack of the Model 850. Rotate the COLOR switch to the R-Y position. The PATTERN switch, of course, should be in the COLOR position. Rotate the GUN KILLER to the B DEMOD. position. A pattern similar to that shown in Fig. 20 should appear.

Adjust the Hue control on the receiver until the three sections between sync pulses are approximately in line. See Fig. 21.

Rotate the COLOR switch to the B-Y position, and the GUN KILLER switch to the R. DEMOD. position. Again, a straight line similar to what you just noticed should appear. If it does not, this indicates that the demodulators are out of alignment. In this case, adjust the B-Y demodulator until a straight line appears. Rotate back to the R-Y position and set the GUN KILLER switch to the B DEMOD. position and adjust the B-Y demodulator. When the demodulators are correctly set, you will note that when R-Y is fed in and the GUN KILLER is in the B DEMOD. position a straight line results and when B-Y is fed in and the GUN KILLER is in the R DEMOD. position a straight line likewise results while leaving the Hue control in the same position. The three parts might not be completely straight in some receivers, but as long as they are all about the same average level, correct alignment has been achieved.

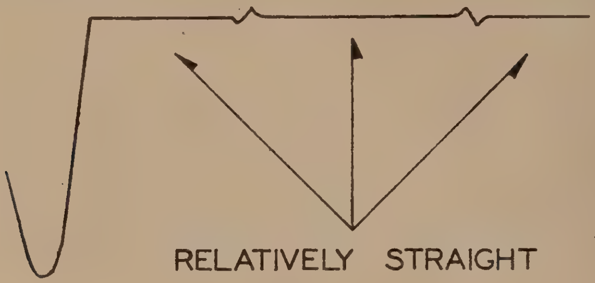


Fig. 21.

COLOR FIDELITY. Once the demodulators have been aligned properly, a final test may be made on the receiver by returning the GUN KILLER to the NORMAL position, and rotating the COLOR switch through its various colors. Make certain that the background brightness is correct and the chroma amplifier control is sufficiently advanced to see the colors on the screen. The colors appearing in the PATTERN DISPLAY STANDARD window may not be identical with that on a particular receiver, but should be relatively close. The important colors to check would be the red, blue and green. This means that the set is capable of producing all of the colors and covers the full phase shift range.

Momentarily switch the COLOR SYNC switch away from the NORMAL position. The color should hold in sync on the screen. Release the switch to the NORMAL position. If it does not the color sync circuit or color killer circuits may require adjustment. The color may change hue during the low level color sync test, but this should not be of concern.

Further Tests of the Receiver

Turn the receiver off and disconnect the leads from the Generator to the receiver. Replace the kinescope socket back onto the CRT and turn the set back on again. Connect the antenna lead-in to the antenna terminals of the receiver. Tune in a strong black and white station. Adjust the color killer control, if present, until no color gets through into the picture. Switch, if possible, to a color broadcast and make sure that a color picture is seen. Check for skin tones with the Hue control.

SIGNAL INSERTION

The Model 850 may also be used as a signal insertion device. Connect a lead from the GROUND jack of the Model 850 to the ground of the receiver. A lead low brought to the VIDEO JACK will have ± video on it depending upon the setting of the VIDEO POT. The center, or zero position, of the VIDEO POT has relatively zero output.

Trouble Shooting by Video Signal Insertion

The Video Signal consists of horizontal and vertical sync pulses and the video information determined by the PATTERN switch.

In the DOTS position horizontal and vertical sync pulses are produced along with 189KC pulses at 1/900 of a second intervals.

In the CROSSHATCH position horizontal and vertical sync pulses are produced along with 189KC and 900 cycle pulses.

In the VERTICAL position horizontal and vertical sync pulses are produced along with 189KC pulses.

In the HORIZONTAL position horizontal and vertical sync pulses are produced along with 900 cycle pulses.

In the COLOR position horizontal and vertical sync pulses are produced along with 3.579545mc color information at 31.5KC intervals. Burst is also present.

When using the video signal for signal insertion examine the schematic of the receiver carefully since there are so many interdependent circuits. As an example, if you fed into the luminance amplifier, no synchronization would be accomplished in the rest of the receiver. Neither would there be any chroma signal into the chroma circuits.

It is desirable, therefore, to achieve synchronization. This may be accomplished by feeding from the RF output of the Model 850 into the antenna terminals of the receiver and then connecting the video output of the 850 to the various grids of the luminance amplifiers. The pattern is then observed on the color tube.

The above assumes that the signal was not getting through to the luminance amplifiers. If it were and we then injected another signal from the 850 directly to the grids of the luminance amplifier, the two signals would interfere with each other.

For your convenience we have included the color section of the Zenith Model 29JC20 schematic diagram. It is assumed in all the following cases that an RF signal from the 850 is also being fed to the antenna of the color set in order to achieve synchronization of picture. See Figure 22.

Signals may be injected from the video output jack at the following points:

For Black & White the PATTERN switch should be in CROSSHATCH, DOTS, HORIZONTAL OR VERTICAL lines position. In Color in the COLOR position.

C-1 produces color and black and white.

Pin 2 of V-7 produces black and white only

Pin 2 of V6B produces color

Pin 5 of V-13 produces color

Pin 6 of V-14 produces color

Pin 6 of V-15 produces color

The colors displayed on the color tube, during Signal Injection, will not necessarily be of the correct hue, nor will they be free of beats. They will, however, prove whether a signal gets through a particular stage; this is the important point.

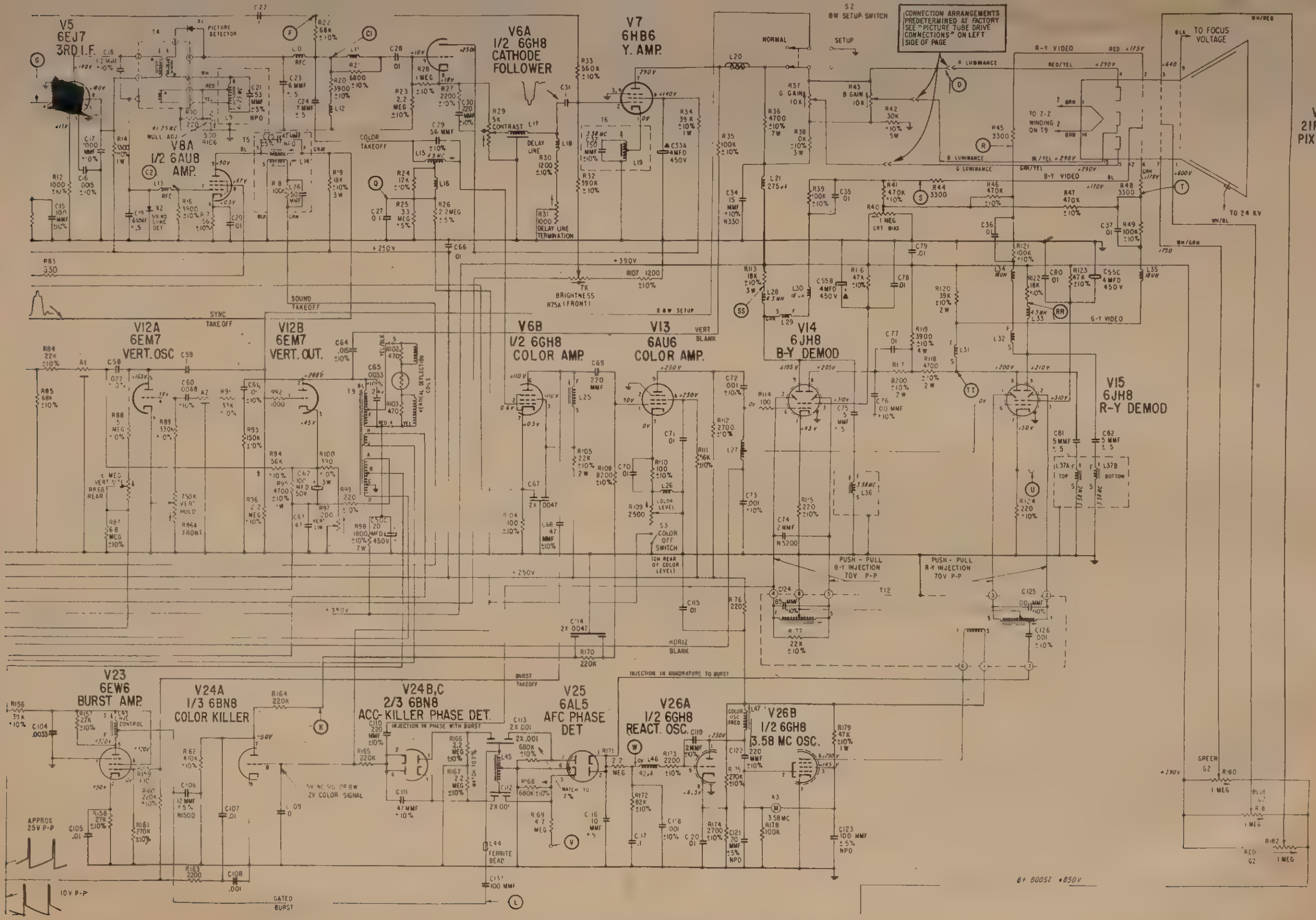


Fig. 22—Zenith Model 29JC20 (Color Section).

MODEL 850 CIRCUIT DESCRIPTION

Fig. 23 shows a block diagram of the Model 850. A 189 kc crystal oscillator synchronizes a 31.5 kc multivibrator by means of a count down of six. The 31.5 kc multivibrator, by means of a seven count down, synchronizes the 4.5 kc blocking oscillator. The 4.5 kc blocking oscillator is divided down by five and synchronizes the 900 cycle blocking oscillator. The 900 cycle blocking oscillator divides down by three and synchronizes a 300 cycle blocking oscillator. The 300 cycle blocking oscillator in turn divides down by five and synchronizes a 60 cycle blocking oscillator. The 31.5 kc multivibrator goes through a transistor shaper and divides down by two. It then synchronizes a 15,750 cycle blocking oscillator. This insures that all frequencies in the count circuit are crystal controlled.

The output of the 15,750 cycle blocking oscillator is shaped in a transistor circuit and forms the horizontal sync pulse. The output of the 60 cycle blocking oscillator goes to a 60 cycle transistor shaper and forms the 60 cycle vertical synchronizing pulse. A signal from the 900 cycle blocking oscillator is shaped in a transistor circuit and when selected by the PATTERN switch forms the HORIZONTAL LINES. A signal from the 189 kc crystal oscillator is fed to a transistorized Schmitt trigger circuit and forms 189 kc pulses. These pulses when fed into the PATTERN switch form the VERTICAL LINES.

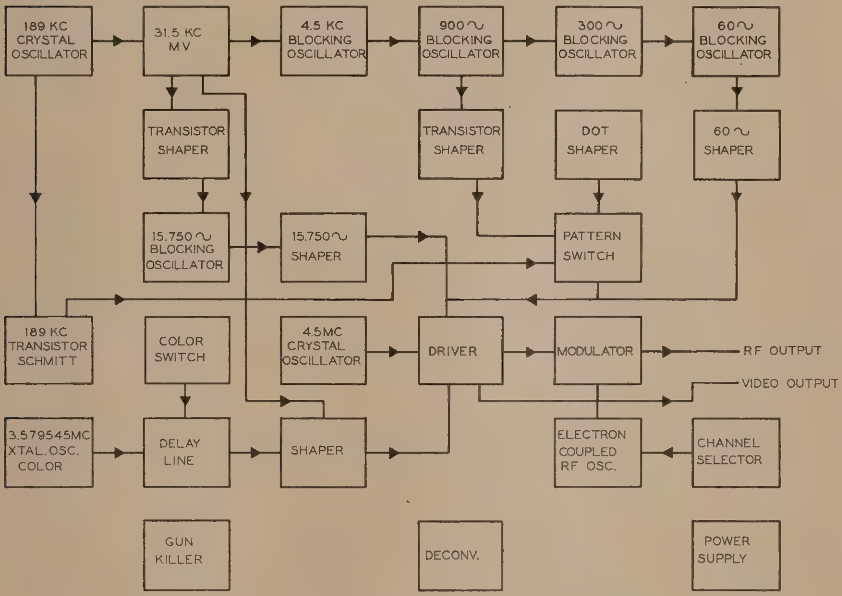


Fig. 23.

When the signal from the 900 cycle transistor shaper are mixed with the signals from the 189 kc transistor Schmitt, a CROSSHATCH pattern results. In the DOT position the crosshatch is fed through a dot shaping circuit and becomes the dot pattern.

From the pattern switch the signals are fed to a driver which in turn feeds into a modulator. Also feeding into the modulator is the output of the electron coupled

R.F. oscillator which becomes the video carrier. The output of the modulator feeds out into the R.F. output cable. The R.F. electron coupled oscillator is switch selected to Channels 3, 4 or 5. These correspond to frequencies of 61.25 mc, 67.25 mc, and 77.25 mc respectively.

A 4.5 mc crystal oscillator also feeds into the driver and becomes the sound carrier.

COLOR. A 3.579545 mc electron coupled crystal oscillator feeds the burst signals into the driver. The same oscillator signal also feeds into the delay line which delays (or phase shifts) the 3.579545 mc signal to correspond with the desired N.T.S.C. color. This is the Chroma information. The output of the delay line feeds into a transistor shaping circuit which is keyed by the 31.5 kc multivibrator in such a manner that it blanks out the color in the center wedge of the display. The output of the transistor shaper feeds into the driver.

The GUN KILLER individually shorts out one or more of the grids of the cathode ray tube in the color set. In the DEMOD. position it selects the grid to be viewed on an oscilloscope.

The DECONVERGENCE ASSEMBLY spreads the signal dot into a dot trio.

The power supply supplies the positive and negative voltages required, it is transformer operated from the 117 volt AC line.

MAINTENANCE

Do not under any circumstances adjust the coils in the delay line as they have been factory adjusted and a delay line is inherently very stable. If for any reason one of the coils should become defective, send to the factory for a replacement part giving the 2 dot color coding on the coils and part number obtained from parts price list.

If any part or component has to be removed from the printed circuit board, use a small pencil type low wattage soldering iron being very careful not to cause any solder cross-over, or overheating of the board.

When replacing pilot lights, make certain you replace them with the exact number pilot light that was removed.

To remove the instrument from the cabinet, unscrew the 6 Phillips head screws on the front panel and the 2 rear rubber bumpers at the bottom of the cabinet.

Loosen the screw inside of the rear compartment. This will allow the round drop door to swing down permitting the cables to be pulled through the hole in the cabinet.

The metal mirror was chosen instead of glass to avoid breakage. When cleaning the mirror use a soft damp cloth. Do not use paper as this may mar the finish.

If for any reason the pattern or color, or gun killer wheels should get out of alignment, there is a set screw holding the pattern and color wheel on their respective switch shafts. The position of the gun killer wheel is adjustable from inside the GUN KILLER switch.

The entire count from 189 kc down to 60 cycles has been designed with extreme stability in mind. You will note the capacitors used are polystyrene which have very little, if any, temperature or aging characteristics. It is conceivable, however, that some change in a tube or other component might result in the train going out of synchronization.

For this reason, we have included the waveforms that will be encountered at a test point for each of the counters.

Allow the Model 850 to warm up for at least an hour at 117 volts AC and then, using a low capacity probe and a wide band oscilloscope, go to each one of the test points in succession. Start with the 189 kc oscillator and go down.

If a waveform is encountered which is not similar to the one shown in Fig. 24, adjust the potentiometer which controls that waveform. You will note that the potentiometer will hold the waveform desired over some rotation. The optimum position is in the middle of the rotation which holds the waveform steady and with the correct number of sync pulses. (Fig. 24 is on separate sheet.)

If any part, or parts, are found to be defective they should be replaced with the identical B & K parts. If a tube is changed, allow the instrument to remain on for at least 12 hours before making your final adjustments.

Fig. 25 shows the location of each of the other internal adjustments for the rest of the waveforms.

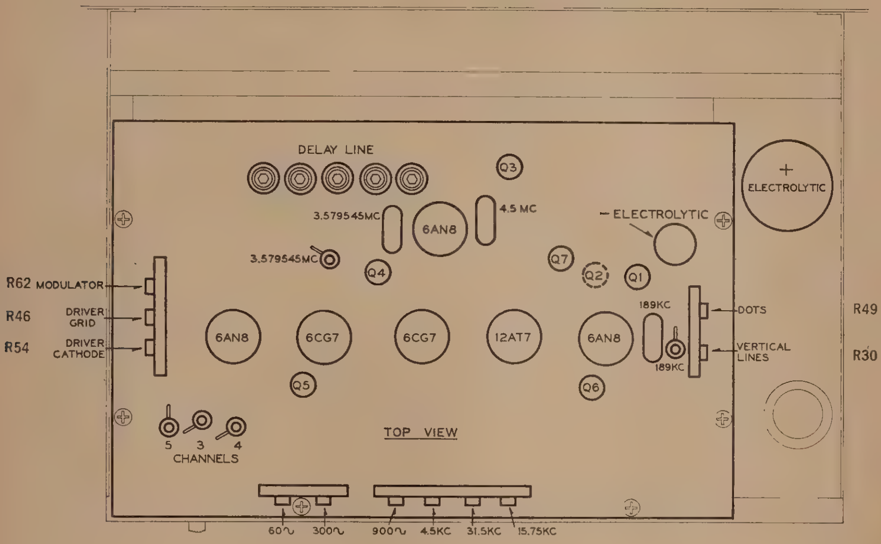


Fig. 25

Potentiometer R-30 adjusts the setting of the 189 kc Schmitt trigger. This, as was previously discussed, develops the vertical lines. Since the rise times from the output of this circuit are extremely fast and normally beyond the ability of the average oscilloscope, it is best to view the vertical lines on a television set.

The vertical line pattern should be tuned in on the TV set in the normal way, and if the lines are too bright, or too dim, they can be adjusted by adjusting R-30. Again we caution the operator not to make these adjustments unless absolutely necessary.

Once you adjust the vertical lines, switch to the CROSSHATCH position and see that the vertical lines have approximately the same brightness as the horizontal lines. Before making the adjustment, see whether you can bring the intensity of both of them to about the same level with the fine tuning control of the receiver. If fine tuning equalizes the intensity, leave the vertical lines as they were. If it does not, the adjustment should be made.

If you now switch to the DOT position on the PATTERN selector, the overall intensity of the dot can be adjusted by adjustment of potentiometer R-49.

Potentiometer R-46 sets the level of the sync information going to the grid of the driver. This may be adjusted by setting the voltage from its rotor to ground at —1 volt.

Potentiometer R-54 controls the percentage modulation. The easiest way of adjusting this is to make certain that the voltage from the rotor of R-54 to ground is +1.85 volt, and the voltage from the rotor of R-62 to ground is +1.85 volt. These voltages should be measured when the instrument is in the CROSSHATCH position. An accurate VTVM should be used. View a crosshatch pattern on a color set when adjusting R-62. Leave in the position where you have the most stable pattern with maximum contrast. Make certain the other positions on the PATTERN switch come in clearly.

The 3.579545 mc crystal in the color oscillator should rarely require any adjustment. It is adjusted by means of the trimmer across the crystal. The location of this trimmer is shown in Fig. 25. Adustment should be made at an authorized field agency.

The frequency of the 189 kc crystal oscillator is controlled by the trimmer across that oscillator. Its location is shown in Fig. 25. This should not have to be adjusted.

The R.F. electron coupled oscillator is adjustable by trimmers C-43, C-44 and C-45. Adjustments should be made, if necessary, by first adjusting C-43 for Channel 5, then C-44 for Channel 4 and finally C-45 for Channel 3. The CHANNEL switch should be in its proper switch position during each setting. Do not adjust unless you have proper frequency measuring equipment.

The design consideration in the DECONVERGENCE ASSEMBLY was such that very little residual magnetic field should be retained when the DECONVERGENCE switch is turned off. If, however, you note that the DOTS or whatever pattern you are looking at tend to spread slightly when the DECONVERGENCE ASSEMBLY is placed into position on the neck of the tube, it is conceivable that the residual field has remained. In this case, pass the DECONVERGENCE ASSEMBLY through your degaussing coil and slowly move it to at least 10 feet away from the coil before turning the coil off.

AGC ADJUSTMENT

After adjusting the TV set with the Model 850, the AGC should be tested. To check the adjustment of the AGC Control, tune in a strong station and sync the picture. Momentarily remove the signal by switching off channel and then back. If the picture reappears immediately, the receiver is not overloading due to improper setting of the AGC control. If the picture takes more than a second to reappear, or loses sync, the AGC should be readjusted.

AGC may be adjusted by turning the control to minimum, then advance until there is a very slight loss of sync in the picture; then turn control just sufficiently to synchronize.

WARRANTY SERVICE INSTRUCTIONS

1. Refer to the maintenance section of the instruction manual for adjustments that may be applicable.
2. Check common electronic parts such as tubes and batteries. Always check instruction manual for applicable adjustments after such replacement.
3. Defective parts removed from units which are within the warranty period should be sent to the factory prepaid with model and serial number of instrument from which removed and date of instrument purchase. These parts will be exchanged at no charge.
4. If the above mentioned procedures do not correct the difficulty, pack the instrument securely (preferably double packed). A detailed list of troubles encountered must be enclosed as well as your name and address. Forward prepaid (express preferred) to the nearest B&K authorized service agency.

Contact your local B & K Distributor for the name and location of your nearest service agency, or write to

Service Department
B&K MANUFACTURING COMPANY
DIVISION OF DYNASCAN CORPORATION
1801 W. Belle Plaine
Chicago 13, Ill.

WARRANTY

"B & K warrants that each instrument manufactured by it will be free from defects in material and workmanship under normal usage and service for a period of ninety days after its purchase new from an authorized B & K distributor. Our obligation under this warranty is limited to repairing, or replacing any instrument or component which we are satisfied does not conform with the foregoing warranty and which is returned to our factory or our authorized service contractor, transportation prepaid, and we shall not otherwise be liable for any damages, consequential or otherwise. *The foregoing warranty is exclusive and in lieu of all other warranties (including any warranty of merchantability), whether express or implied.* Such warranty shall not apply to any instrument or component (i) repaired or altered by anyone other than B & K or its authorized service contractor (except normal tube replacement) without B & K's prior written approval; (ii) tampered with or altered in any way or subjected to misuse, negligence or accident; (iii) which has the serial number altered, defaced or removed; or (iv) which has been improperly connected, installed or adjusted otherwise than in accordance with B & K's instructions. B & K reserves the right to discontinue any model at any time or change specifications or design without notice and without incurring any obligation. *The warranty shall be void and there shall be no warranty of any instrument or component if a B & K warranty registration card is not properly completed and postmarked to the B & K factory within five days after the purchase of the instrument new from an authorized B & K distributor."*

B & K MANUFACTURING COMPANY
DIVISION OF DYNASCAN CORPORATION
1801 W. BELLE PLAINE AVE. • CHICAGO, 13

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INSTRUCTION
MANUAL

B&K Model 466

CATHODE RAY TUBE
TESTER/REJUVENATOR

B&K
Product of DYNASCAN CORPORATION
1801 West Belle Plaine Avenue, Chicago, Illinois 60613

INSTRUCTION MANUAL

FOR

Model 466

CATHODE RAY TUBE TESTER/REJUVENATOR

B & K *DIVISION OF DYNASCAN CORPORATION*
1801 West Belle Plaine Avenue
Chicago, Illinois 60613

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BRIEF SUMMARY OF
WHAT THE MODEL 466 WILL DO

1. The Model 466 CRT Tester/Rejuvenator will rapidly test a cathode ray tube (using CRT manufacturers' accepted techniques and safeguards) for all the important factors which determine the quality of a tube. The Model 466 will check for shorts or leakage between the elements in the tube and will also indicate between which elements the fault exists.

2. The 466 will check the amount of emission from the cathode (s) and will directly and rapidly indicate relative emission balance between the guns of a color cathode ray tube.

3. The 466 will check the warmup characteristics of a tube.

4. It will repair most common faults in cathode ray tubes, such as shorts between elements, open connections to elements, and inter-element leakage.

5. It will rejuvenate picture tubes having low emission. Other capabilities of the Model 466 are described in the next section.

WHY YOUR NEW MODEL 466 IS THE MOST ADVANCED TESTER OF ITS TYPE

The Model 466 CRT Tester/Rejuvenator has been designed by B&K to accurately evaluate virtually any television cathode ray tube.

This professional quality CRT tester retains the proven, valuable capabilities of its predecessors and also incorporates new important advances. These advances include:

1. A human-engineered control panel which organizes and streamlines the test by guiding the user rapidly through the correct test sequence.
2. Advances in internal circuitry which provide more directly useful features and greater test precision than any comparable tester.
3. A large precision meter which is numerically coded to the front-panel controls to minimize setup time and permit highly accurate, error-free evaluation of the CRT under test.
4. Color-coded: leakage and emission scales.
5. G_1 voltage and heater voltage (right at the tube pins) are precisely monitored on meter.
6. Continuously variable heater voltage, which can be precisely set on meter, effectively protects the instrument from obsolescence by the appearance of future CRTs having new heater voltages.
7. The voltages to grid 1 and grid 2 are continuously variable permitting the tube to be checked under conditions similar to operation of the tube within the receiver.
8. Improved power supply transformer provides greater safety and up-to-date comprehensive coverage of all new filament voltages.
9. New color tracking normalize feature which greatly simplifies color tube evaluation and reduces time for determining proper color gun tracking.
10. New simplified warmup test for color CRTs.
11. Direct metering of relative cathode emission improvement when using any of the Rejuvenate features. This eliminates need to repetitiously

recycle previous test steps, saves time and permits immediately detecting the extent to which rejuvenation should be performed.

12. Simplified life test.

13. Activate mode provides precise metered monitoring of activation.

14. Rejuvenation capability is provided in three improved steps, the first two of which are automatically timed to prevent damage to a tube. The unique Super Rejuvenate feature provides even greater capability for restoring the emission of an aging and otherwise worthless CRT.

15. The largest storage space of any CRT tester currently available.

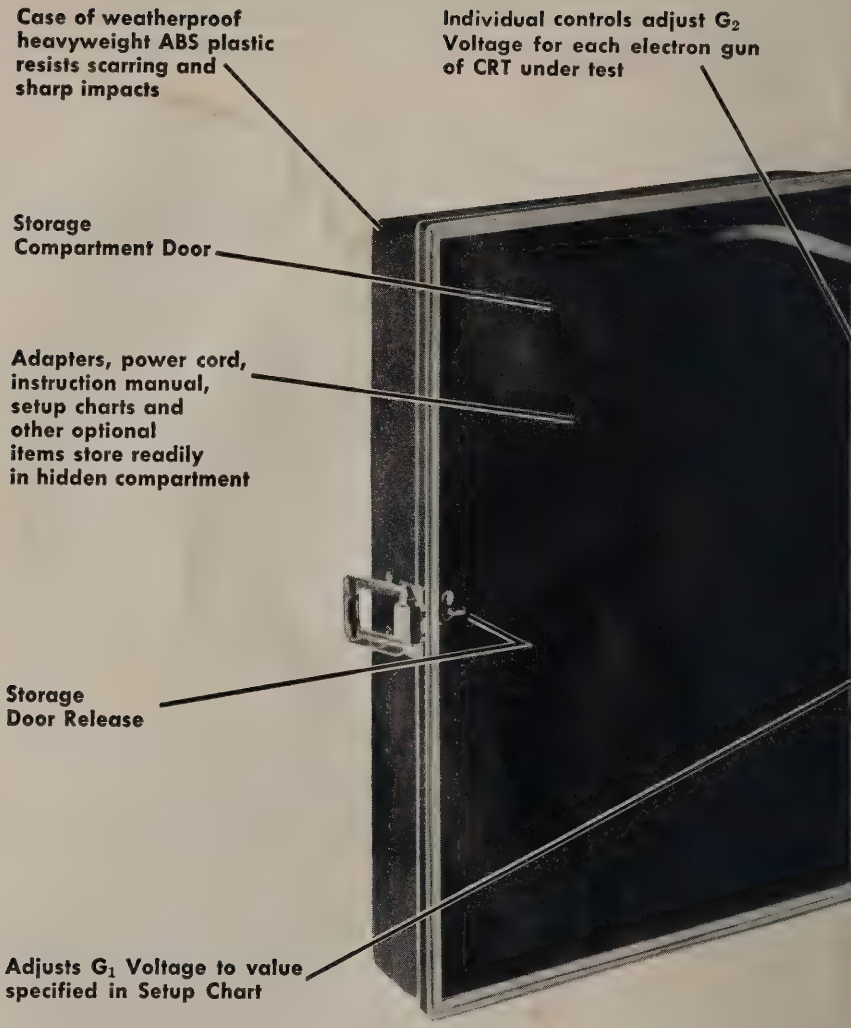
16. New improved, expanded, more versatile adapter set is included and provides capability to directly test more CRT types than any other currently available tester. For example, even the new Trinitron, 11SP22 and 11WP22 tubes are accurately tested on the 466 without having to obtain additional adapters at added cost.

17. Unlike other CRT testers which allow some of the internal elements of a color CRT under test to "float at random" or to be shorted together (to reduce cost of the tester), in all test modes the 466 insures that all key elements of the color CRT are properly connected to appropriate test circuit points. This permits greater precision in test results and eliminates the real possibility of any uncontrolled, internal current paths injuring the CRT under test.

Safety Precautions

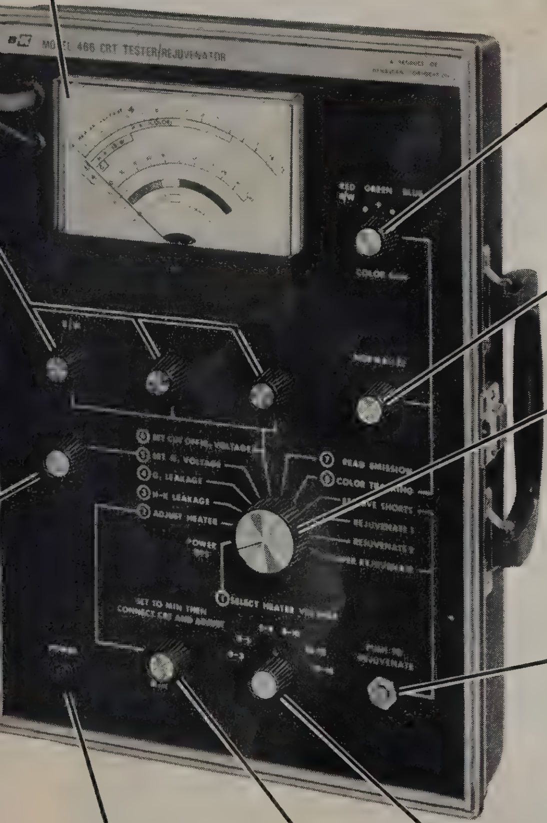
NOTE: The proper power line supply voltage is indicated in the line cord storage compartment. Do not attempt to operate this instrument from a power source other than specified.

When testing any CRT that is installed in a chassis, first disconnect the chassis power plug from the AC line outlet. DO NOT APPLY POWER TO THE CHASSIS AT ANY TIME DURING THE TEST OF THE CRT. Remove the receiver female socket assembly from the base of the CRT. Always perform test steps carefully.


Case of weatherproof heavyweight ABS plastic resists scarring and sharp impacts
Individual controls adjust G_2 Voltage for each electron gun of CRT under test
Storage Compartment Door
Adapters, power cord, instruction manual, setup charts and other optional items store readily in hidden compartment
Storage Door Release
Adjusts G_1 Voltage to value specified in Setup Chart

BASIC FEATURES OF MODEL 466

Meter scales are sequentially numbered with circled numbers which tie in with circled numbers on step-by-step front panel of 466 tester.



Color Gun Switch selects electron gun to be tested, activated or rejuvenated. See instructions.

Normalize Control simplifies Color Tracking test

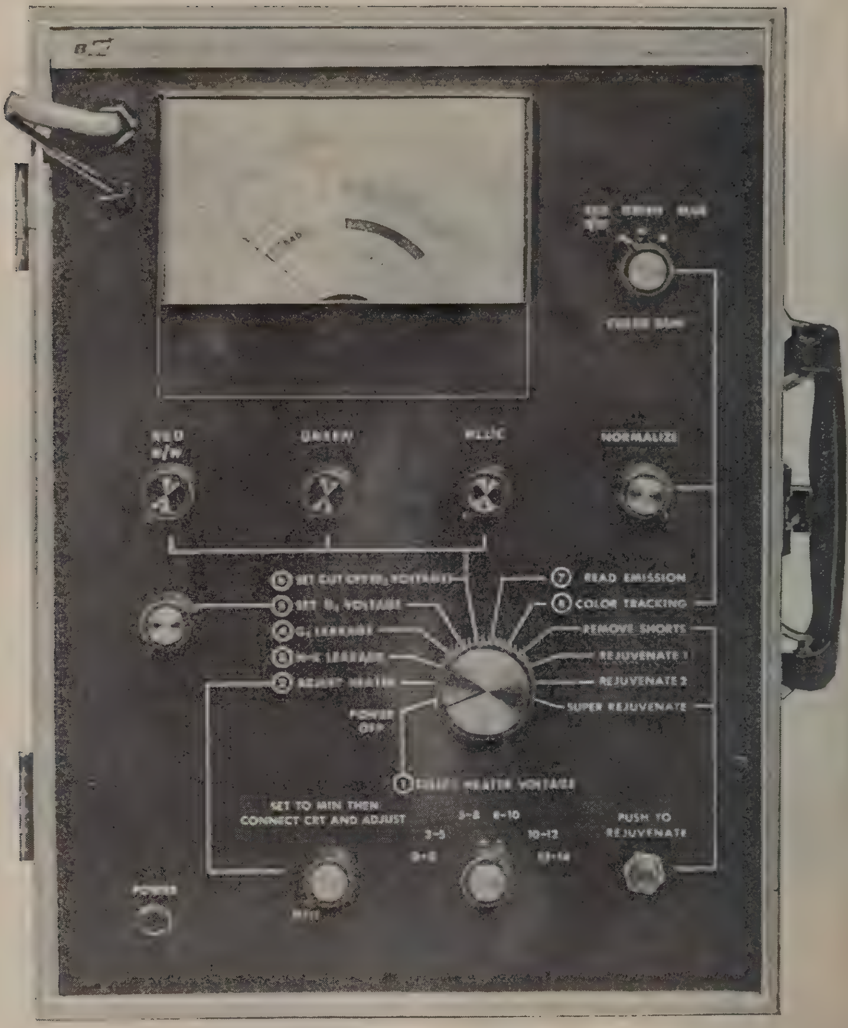
LARGE CENTRAL FUNCTION KNOB CONTROLS STEP-BY-STEP SEQUENCE OF TESTING

RED REJUVENATE PUSHBUTTON (read instructions before using).

Power On Indicator

Adjusts Heater Voltage to Exact Value specified in Setup Chart

Selects Heater Voltage Range



CONTROL PANEL OF MODEL 466

PREPARATION FOR TEST

Connect line cord of tester to proper power line outlet, rotate NORMALIZE control completely clockwise and all other controls completely counterclockwise. Find the listing in the test chart for the CRT to be tested. Note the sequential numbering on the front panel of the 466 which will guide you rapidly through the test sequence. Circled numbers below correlate with circled numbers on panel and meter of tester.

The 466 tests both black-and-white and color CRTs in an essentially identical manner, except that the top switch marked COLOR GUN is always kept in the position marked RED/B&W for a black-and-white tube but is switched into each of its three color gun positions for steps ③, ④ ⑥, and ⑦ when testing a color CRT.

SIMPLIFIED TEST PROCEDURE

① Rotate bottom knob marked ① SELECT HEATER VOLTAGE to proper range as indicated in setup chart.

② Rotate large central function knob to position marked ② ADJUST HEATER. Follow guideline, set small knob to MIN, select adapter indicated in chart, connect CRT, adjust heater voltage as indicated on scale ② of meter to value given in chart. Allow CRT to warmup for at least three minutes. Readjust heater voltage.

SET HEATER

③ Rotate the large function knob to ③ H-K LEAKAGE and observe reading on LEAKAGE scale ③ of meter. (There are two scales for H-K leakage. One is for color CRTs and the other for black-and-white CRTs. Be sure to take your reading from the appropriate scale for the type of CRT under test). The colored area indicates the range of permissable leakage. Readings outside this area indicate a defective tube. For a color CRT repeat this step for all positions of the COLOR GUN switch.

④ Rotate the large function knob to ④ G_1 LEAKAGE. Observe meter reading on scale ④. For a color CRT repeat this step for all positions of the COLOR GUN switch. For both black-and-white and color tubes, if the reading is outside the colored area, the tube is defective and should be rejected.

COMMENTS:

Tap lightly on the neck of the tube during the above leakage tests ③ and ④. Erratic meter readings may indicate an intermittent or short condition. Leakage can be caused by an accumulation of dust at the base pins of the CRT. Cleaning the tube base with a non-toxic, non-conductive solvent such as methyl alcohol, will frequently remedy this problem.

LEAKAGE & SHORTS TEST

EMISSION TEST

⑤ Set large function knob to ⑤ SET G_1 VOLTAGE and using knob ⑤ adjust G_1 voltage on meter scale ⑤ to green line = 45 volts. *For tubes marked with an asterisk *, set G_1 to 70 volts.

⑥ Set large function knob to position ⑥ and with COLOR GUN switch in position marked RED/B&W adjust B/W RED G_2 voltage control knob until meter pointer reading on meter scale ⑥ increases by two small divisions. (If pointer is beyond limit of scale ⑥ or if you can't adjust pointer by two divisions on scale ⑥, CRT is bad.) For a color CRT perform this step once for each of the three positions of the COLOR GUN switch, using the corresponding control.

⑦ Set function switch to ⑦ READ EMISSION and evaluate the emission on meter scale ⑦. If meter reads BAD, reject the tube. If meter reads GOOD, cathode emission is acceptable. For a color CRT, perform this step in all three positions of COLOR GUN switch.

The following step applies only to color CRTs.

COLOR TRACKING

⑧ a. Set function switch to ⑧ COLOR TRACKING position.

b. While observing meter pointer, rotate COLOR GUN switch in all three positions, then set to gun with highest reading on meter.

c. Adjust NORMALIZE control until meter pointer aligns on the right edge of the color tracking rectangle (marked NORMALIZE).

d. Switch the COLOR GUN switch to each of the other two color guns. If the meter does not read within the boundaries of the color tracking rectangle for all three guns, reject the tube if IN-WARRANTY. If tube is OUT-OF-WARRANTY, consider using ACTIVATE/REJUVENATE procedure for the color gun having the lowest emission reading.

COMMENTS

A zero reading when the Function Switch is in the READ EMISSION position ⑦ indicates an open G_2 or K element. The G_2 voltage control ⑥ should be set carefully so that erroneous reading and tube damage are avoided.

SIMPLIFIED WARMUP TEST FOR COLOR TUBES

To produce satisfactory colors in operation, the emission of each of the three guns of a color picture tube must approach its normal operating value within a reasonable time period. One of the unique features of the 466 is that it provides a very easy, simplified technique for determining the warmup characteristics of color tubes as follows.

1. After the standard test steps ① thru ⑦ and the Color Tracking evaluation step ⑧ have been completed on a color tube and the tube has been evaluated as acceptable, leave all settings of the small knobs unchanged and rotate the large function knob to the OFF position for 10 minutes or until CRT cools down completely.

2. Leaving all small knobs still undisturbed, rotate large function knob back to position marked COLOR TRACKING. Wait 2 minutes and then successively rotate the COLOR GUN switch into all three of its positions while observing meter position relative to the acceptable tracking area indicated on scale ⑧ of the meter. If the meter needle deflects into the acceptable color tracking rectangle of scale ⑧ for all guns at the two minute point, the warmup characteristic of the CRT is considered to be acceptable.

3. If any gun failed step ②, above, wait two more minutes and then (leaving all other controls still undisturbed) again rotate the COLOR GUN switch into all three positions while observing meter. If the meter needle deflects into the acceptable color tracking rectangle for all three guns at this time (after a total of four minutes of warmup), the warmup characteristic of the CRT is considered to be marginally acceptable.

LIFE TEST

1. Set the function switch to position ⑦ READ EMISSION until CRT is up to operating temperature.

2. Rotate bottom right knob ① SELECT HEATER VOLTAGE to lowest range. Note the length of time before the meter needle starts to fall toward zero as the CRT cools down.

3. When testing a color tube, repeat steps ①, and ② for all three color guns.

4. If the meter needle momentarily remains fixed or slightly increases and then slowly drops to zero, the tube is accepable. If the meter needle begins to slump toward zero rapidly, then the tube cannot be expected to last much longer.

Note: The emission current in "instant on" CRTs (not preheated filaments) can be expected to decrease quite rapidly, since the thermal time constant of the gun structure is much smaller than for conventional CRTs.

Comment: In this test, the useful life of a picture tube is approximately correlated with the "statistical probability" of electrons being emitted from the cathode surface and passing through the aperture of the electron gun. This, in turn, depends on whether the small portion of the cathode surface nearest the aperture can emit electrons efficiently.
If there is excess gas in the tube, positive ions will have been drawn through the aperture to this crucial portion of the cathode surface. These ions, on striking the cathode surface, "borrow" electrons from the cathode and become atoms attached to the cathode surface. These "contaminating" atoms thus coat the emission surface with a barrier layer which reduces the "statistical probability" that electrons will be emitted as desired. The slump in current (if observed in step 2) indicates this surface contamination. Since the contamination will continue to increase in a "gassy" tube, such a tube cannot be expected to last much longer. A continuing degradation of the emission current can be expected.

REMOVING SHORTS

1. Set large function switch to REMOVE SHORTS position.
2. Allow five to ten minutes for the filament to cool. Heater voltage is not applied to the tube during this function.
3. When repairing a color tube, set the COLOR GUN switch to the gun being repaired. For a black-and-white tube, set the switch to the B/W position.
4. Press red REJUVENATE pushbutton momentarily.
5. Repeat the SHORTS test steps ③ and ④ to determine whether or not the short has been removed. If a short has been removed, proceed with emission test (steps ⑤ thru ⑦).

COMMENTS: When the tube in the Shorts test shows a cathode to filament short, do not attempt to repair it. If the tube functions properly in the set, it is unnecessary to do any more to it. However, if the picture is bad (due to possible hum in the picture or no control of brightness), the picture tube can still be used if a 1:1 filament isolation tranformer is wired into the set.

ACTIVATE MODE

The activate mode of the Model 466 comprises a mild form of rejuvenation and can be used to increase the emission of some picture tubes when the emission has decreased below the acceptable level. All tubes with low emission cannot be activated—it depends on the condition of the cathode emission surface in the particular tube.

During the activate mode, the heater voltage of the tube is increased, while the emission current flow is maintained. The relative cathode emission can be observed on the meter of the 466 as the tube is activated. Note: Activation of in-warranty color tubes should not be performed.

Activate Procedure

1. After completing normal test steps ① thru ⑦, note emission reading, then rotate function knob back to ② and adjust heater voltage to a value 40% above value specified in setup chart. (Example: If setup chart specified 6.3 v., adjust heater to 1.4 x 6.3 v. = 8.8 v.).

2. Rotate function knob to position ⑦ and note emission reading on meter. Allow the CRT to activate for 5 minutes, while noting the meter deflection. If the pointer moves upward and stabilizes at a higher reading, it is probable that the tube has been activated to the extent possible.

3. Rotate function knob to OFF and wait one minute. Repeat normal steps ②, ③ and ④.

NOTE: Picture tube leakage reading may change after the tube is activated. Allow tube to cool a few minutes until original leakage reading is restored, then perform steps ⑤, ⑥ and ⑦ and note emission reading. If emission is still too low and CRT is out-of-waranty, consider performing Rejuvenation Procedure outlined below.

RESTORING EMISSION

NOTE: Any attempt to bring back the emission by rejuvenating a tube should be done very cautiously, AND ONLY AFTER IT HAS BEEN DEFINITELY DETERMINED THAT THE TUBE IS NO LONGER USEFUL IN ITS PRESENT CONDITION. When rejuvenating a Color tube, make sure you attempt rejuvenation of the defective gun only. Always follow carefully the procedure outlined below.

It is not generally advisable that you attempt rejuvenation of an "in-warranty" tube.

REJUVENATION

1. Set the large function switch to the REJUVENATE 1 position.

2. When repairing a color tube, set the COLOR GUN switch to the gun that is to be rejuvenated. For a black-and-white tube, set the COLOR GUN switch in the "B/W" position. Note precisely the meter pointer position.

3. Press the red REJUVENATE button momentarily. Observe new meter needle position. Repeat step until needle deflects into GOOD area of scale ⑦ or until pointer deflection fails to increase from the previous reading.

4. If meter pointer fails to indicate in GOOD area after Step 3, rotate large function knob to REJUVENATE 2 position, wait 15 seconds for heater

to come up to its new operating temperature, note new meter reading, then momentarily press red REJUVENATE pushbutton. Repeat step until meter reading fails to increase. Do not continue the REJUVENATE process beyond the point where the meter needle ceases to indicate increased relative emission after each release of the REJUVENATE pushbutton.

5. If Steps 3 and 4 (which provide an automatically timed rejuvenate cycle) did not bring the cathode emission to the acceptable level, you have the option of proceeding to the SUPER REJUVENATE step. This last step is manually controlled in duration by the red REJUVENATE pushbutton, when you rotate the large function knob into the SUPER REJUVENATE position.

SUPER REJUVENATION

With function switch in SUPER REJUVENATE position note meter needle position, then press red REJUVENATE button for ¼ to ½ second and release immediately. Observe new meter reading. If emission is still inadequate, wait at least 5 seconds and repeat step until emission fails to increase. Increase time of rejuvenation to 1 or 2 seconds until some improvement in emission is obtained. This SUPER REJUVENATE is not an automatically timed position, so the longer you hold down the red REJUVENATE button, the longer the SUPER REJUVENATE cycle will continue.

DO NOT CONTINUE CYCLING IN ANY REJUVENATE STEP IF THE METER READING DECREASED SLIGHTLY AFTER THE LAST DEPRESSION OF THE RED REJUVENATE PUSHBUTTON. For a SHORTED CRT NEVER USE SUPER REJUVENATE MODE.

NOTE: To avoid accidental application of REJUVENTE voltages to a normal CRT, NEVER LEAVE FUNCTION KNOB IN ANY REJUVENATE POSITION MARKED IN GOLD unless you intend to immediately perform that specific rejuvenation step.

REPAIRING OPEN ELEMENTS

If the tube has an open G_1 or G_2 element, the probable cause is a bad solder connection at the base pins of the picture tube. For an open element, the first step is to try resoldering the base pins. If the tube has an open cathode, it may actually be a break in the weld between the cathode and its connecting tab or very weak emission from the cathode. First, try restoring emission as discussed in "Restoring Emission". If rejuvenation does not help, an attempt can be made to weld the cathode tab as follows:

Turn function switch to Rejuvenate 2 position. With the non-metallic handle of a screwdriver, tap the neck of the tube lightly. Carefully watch as you press the red REJUVENATE button. If the weld takes you will see a bright flash. If the weld does not take, set function knob in SUPER REJUVENATE position and press red REJUVENATE button while lightly tapping neck of CRT. If the weld takes, you will see a bright flash. IMMEDIATELY RELEASE RED PUSHBUTTON. Retest the tube to be sure it will function satisfactorily.

NOTE: When not actively using the 466, rotate the large function knob to the POWER OFF position. Do not pinch line cord between mating aluminum edge extrusions of case when closing cover.

SETUP CHARTS

An up-to-date test chart is included with your Model 466. In order to keep your setup chart up-to-date, it is recommended that you subscribe to the B&K Chart mailing service. These mailings will occur in May and November of each year and will include all the tubes presently listed on your chart plus all new types of CRTs that have come out since the last mailing.

If you wish to take advantage of this service, remit cash, check, or money order (no COD's please) to:

B&K Division of Dynascan Corporation
1801 West Belle Plaine Avenue
Chicago, Illinois 60613

and you will be placed on the subscription list.

466 FIELD CALIBRATION

The Model 466 CRT Tester/Rejuvenator can be recalibrated as follows:

A. HEATER VOLTAGE CALIBRATION

Equipment Needed: An accurate A.C. VOM or VTVM.
Set meter for the AC scale that gives closest full scale reading to 6.3 VAC. Connect meter leads to pins 1 and 12 of socket #1. Plug the 466 line cord into a 117 VAC outlet. Turn the large function switch to the ADJUST HEATER position. Turn the heater selector switch to 5-8 position. Turn the heater adjust pot until the VOM/VTVM reads 6.3 VAC. Adjust R_1, the heater cal trim pot until the 466 meter reads 6.3 VAC on scale ②.

B. EMISSION CALIBRATION

Equipment Needed: A milliammeter and a 100K resistor.
Turn the 466 large function switch to the READ EMISSION position. Turn the color gun switch to the RED-B/W position. Turn the G_2 pots (RED-GREEN-BLUE) to full counterclockwise positions. Set the milliammeter to a range capable of reading 300 microamperes. Connect the negative lead to pin 11 of socket #1. Connect the positive lead to one end of the 100K resistor. Connect the other end of the resistor to pin 10 of socket #1. Slowly turn the red G_2 pot until the milliammeter reads 300μa. Adjust R9, the emission cal trim pot, until the 466 meter reads 50 on scale ⑤.

C. COMPRESSION CALIBRATION

Equipment Needed: A milliammeter and a 100K resistor.
Turn the 466 large function switch to the READ EMISSION position. Turn the color gun switch to the RED-B/W position. Turn the G_2 pots (RED-GREEN-BLUE) to full counterclockwise positions. Set the milliammeter to a range capable of reading 3 milliamperes. Connect the negative lead to pin 11 of socket #1. Connect the positive lead to one end of the 100K resistor. Connect the other end of the resistor to pin 10 of socket # 1. Slowly turn the red G_2 pot until the milliammeter reads 3ma. Adjust R4, the compression adjust trim pot, until the 466 meter reads 100 on scale ⑤.

WARRANTY SERVICE INSTRUCTIONS

1. Service information is available from the factory at the address shown below.
2. Defective parts removed from the unit which are within the warranty period should be sent to the factory prepaid with the model and serial numbers of product from which they were removed. Also, include the date your Model 466 was purchased. These parts will be exchanged at no charge.
3. If you are unable to correct a difficulty, pack the product securely (preferably double packed). A detailed list of troubles encountered must be enclosed as well as your name and address. Forward prepaid (express preferred) to the nearest B&K authorized service agency.

Contact your local B&K Distributor for the name and location of your nearest service agency, or write to

Service Department
B&K DIVISION OF DYNASCAN CORPORATION
1801 West Belle Plaine Avenue
Chicago, Illinois 60613

WARRANTY

"B & K warrants that each product manufactured by it will be free from defects in material and workmanship under normal usage and service for a period of ninety days after its purchase new from an authorized B & K distributor. Our obligation under this warranty is limited to repairing, or replacing any product or component which we are satisfied does not conform with the foregoing warranty and which is returned to our factory or our authorized service contractor, transportation prepaid, and we shall not otherwise be liable for any damages, consequential or otherwise. *The foregoing warranty is exclusive and in lieu of all other warranties (including any warranty of merchantability), whether expressed or implied.* Such warranty shall not apply to any product or component (i) repaired or altered by anyone other than B & K or its authorized service contractor (except normal tube replacement) without B & K's prior written approval; (ii) tampered with or altered in any way or subjected to misuse, negligence or accident; (iii) which has the serial number altered, defaced or removed; or (iv) which has been improperly connected, installed or adjusted otherwise than in accordance with B & K's instructions. B & K reserves the right to discontinue any model at any time or change specifications or design without notice and without incurring any obligation. *The warranty shall be void and there shall be no warranty of any product or component if a B & K warranty registration card is not properly completed and postmarked to the B & K factory within five days after the purchase of the product new from an authorized B & K distributor.*"

DYNASCAN CORPORATION

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INSTRUCTIONS FOR
B & K PRECISION MODEL HV-32 HIGH VOLTAGE PROBE

DESCRIPTION

The B & K HIGH VOLTAGE PROBE is a self-contained direct reading 0 to +30 Kilovolts high voltage meter.

The core magnet type meter is free from outside magnetic influence and can effectively withstand shock and vibration.

The outside case is made of ABS plastic insuring excellent insulation, shock resistance and light weight. Each probe is factory calibrated at 25 Kilovolts to an accuracy which makes this instrument ideal for measuring the high voltage of all makes of color T.V. sets, as well as black and white sets.

SPECIFICATIONS

Range:	0 to +30 KV
Sensitivity:	
Accuracy:	±2% at 25 KV ±3% of full scale overall
Calibration:	Individually calibrated at 25KV.

IMPORTANCE OF MEASURING THE HIGH-VOLTAGE

All color T.V. sets require a specified value of high-voltage. If the high-voltage is incorrect the set may not function properly. Before any color set can be accurately converged the high-voltage must be checked and set per the manufacturer's instructions.

A second reason to check the high voltage arises from the possibility of X-ray radiation from certain sets, particularly old sets. The possibility of this hazard is increased if the high voltage of the receiver is excessively high. Always check the manufacturer's instructions and specifications prior to performing high voltage adjustments.

MEASURING HIGH-VOLTAGE OF T.V. SETS

CAUTION

ALWAYS CONNECT THE GROUND LEAD BEFORE TAKING ANY MEASUREMENTS. Always take measurements with one hand behind your back. Avoid contacting any exposed metal parts. Do not stand on wet floors. A dry piece of plastic is useful as a place to stand.

1. Connect the ALLIGATOR GROUND CLIP to the chassis or ground side. Be sure the tester is free of dust and moisture.
2. Locate the high-voltage point on the picture tube or in the high-voltage compartment.
3. Touch the PROBE TIP to the high-voltage point. Make sure that your free hand is held behind you and that the hand holding the probe is not in contact with any other point. Read the high-voltage on the meter.
4. Remember many picture tubes have conductive coatings which can hold a charge long after the set is turned off.
5. Measure only positive D.C. voltages. The instrument is not designed for either negative or A.C. voltages.

MAINTENANCE

The B & K HIGH-VOLTAGE PROBE is designed to give years of trouble free service. If any malfunction occurs check the following:

1. Ground lead and clip.
2. Probe tip
3. Accumulation of grease or dust.

MODEL HV-32 PARTS LIST
481-041-9-001

SCHEMATIC SYMBOL	DESCRIPTION	B & K PART NO.
	RESISTORS	
R1 R2	300Meg, 4 Watt 5% Resistor	004-107-9-001
R3	30K 1/8 Watt 5% carbon Film Resistor	002-108-5-303
R4	10K 1/8 Watt 5% Carbon Film Resistor	002-108-5-103
VR	200K 20% Trimpot	008-175-9-001
	MISCELLANEOUS	
	Case, Top	380-169-9-001
	Case, Upper	380-169-9-002
	Case, Lower	380-169-9-003
	Window, Transparent	380-170-9-001
	Probe Tip	769-061-9-001
	Nut, Probe Tip	653-015-9-001
	Resistor Holding Spring	767-031-9-001
	Zero Adjust Button	380-171-9-001
	Hardware, Zero Adjust	763-020-9-001
	Movement Mounting Plate	323-009-9-001
	Screw, Movement Mounting Plate	323-009-9-002
	Split Washer, Movement Mounting Plate	323-009-9-003
	Meter Movement, 40μA 2% 3.2K	321-003-9-001
	Scale Plate	322-019-9-001
	Screw, Scale Plate	323-009-9-004
	Split Washer, Meter Movement	323-009-9-005
	Alligator Clip	741-063-9-001
	Screw, Case	634-042-9-002
	Split Washer, Case	731-023-9-002
	Insert Plug, Plastic	380-172-9-001
	Printed Circuit Board	302-131-9-001
	Sleeve, Carton	502-066-9-001
	Polyfoam Box	500-212-9-001
	Transparent Cover	500-212-9-002
	Instruction Sheet	481-041-9-001

The meter is individually factory calibrated and should not require adjustment. If after examining the tester it still fails to perform satisfactorily contact your local distributor for the name and location of your nearest service agency or write to:

Service Department
B & K Division of Dynascan Corporation
1801 W. Belle Plaine Ave.
Chicago, Illinois 60613

PRINTED IN JAPAN

B+K PRECISION

DYNASCAN CORPORATION

6460 W. Cortland St., Chicago, Illinois 60635

INSTRUCTION MANUAL

B+K PRECISION 1827

6-DIGIT AUTORANGING FREQUENCY COUNTER

B+K PRECISION

Product of DYNASCAN CORPORATION
6460 W. Cortland St., Chicago, Illinois 60635

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INTRODUCTION

Your new frequency counter is a high-quality, lightweight, autoranging counter designed for frequency measurement in the range from 100 Hz to 30 MHz. A front panel function switch selects 1 SEC preset gate interval or AUTO range. In the AUTO position, the correct gate interval for maximum resolution without overranging the instrument is automatically determined and proper frequency unit indicators for kHz or MHZ are turned on. In the 1 SEC position, the display will indicate frequency to the closest Hz even if the leading most significant digit (MSD) is beyond the display range.

The display consists of six 7-segment, LED numerical display units and three LED's (light-emitting diodes) for units and overrange indication.

An internal time base of 4 MHz is generated by a crystal-controlled oscillator.

Rugged, compact design and exceptional accuracy combine to make this counter a valuable tool for the scientist, engineer, experimenter, hobbyist, and service technician. It not only is an excellent instrument for the laboratory, but also is rugged and compact for use in the field. It is low in power consumption and operates on 6 "AA" batteries, optional BC27 charger/adapter, or external DC.

SPECIFICATIONS

1. FREQUENCY CHARACTERISTICS

Range	100 Hz to 30 MHz (guaranteed) Function switch selects kHz or AUTO display reading.
Gate Time, Auto	10 mSEC or 100 mSEC (MHz reading), or 1 SEC (kHz reading), chosen automatically.
Accuracy	± Time base accuracy, ± 1 count.
Resolution	1 PPM of a 6-digit scale.
Display	Frequency of input signal with automatically positioned decimal point. Units of measurement (kHz, MHz) displayed on front panel by illuminated indicator.

2. INPUT CHARACTERISTICS

Impedance	10,000 ohms minimum.
Connector	RCA phono type.
Sine Wave Sensitivity	200 mV RMS; 100 Hz-200 kHz. 100 mV RMS; 200 kHz-30 MHz.
Maximum Input	200 V (peak AC + DC) to 500 Hz; derate linearly to 100 V (peak AC + DC) at 1 kHz; derate linearly to 25 V (peak AC + DC) at 30 MHz.

3. INTERNAL TIME BASE CHARACTERISTICS (REFERENCED TO 25° C)

Type	Crystal Oscillator.
Frequency	4.0 MHz.
Setability	± 0.25 PPM (± 1 Hz).
Temperature Stability	Better than ±0.001% (i.e. ±10 PPM) from 0-50°C ambient.
Maximum Aging Rate	10 PPM/Year, 1/PPM Month.

4. DISPLAY CHARACTERISTICS

Visual Display	6 digits with overflow, kHz and MHz indicators and anti-glare window.
Overflow Indication	Flashing light indicates display range is exceeded.
Display Refresh Interval	Fixed; 200 mSEC plus gate interval.
Battery Saver	The digits of the display are blanked in battery operation until the DISPLAY button is pushed. The display will remain on as long as the button is depressed and for an additional 10 seconds after released. External power defeats the battery saver and the displays will stay on continuously.

5. GENERAL

Power Requirements	Operates on 6-9V (6 "AA" Batteries); or 6.7 to 9.7 V at external power jack input.
Dimensions	6-5/8" D x 3¾" W x 1¾" H (17 x 9½ x 4½ cm).
Shipping Weight	Less than 1 lb. with batteries.
Accessory Cable CC - 51 (Supplied)	RCA phono-to-clip lead cable.

OPTIONAL ACCESSORIES (Not Supplied)

BC - 27	AC adapter and charger.
BP - 27	Battery Pack (6-AA NiCad rechargeable cells).
SA - 12	12 V automotive power cord.
CC - 52	DC power supply cord.
SA - 10	Signal tap with RCA plug-on tap cable.
MB - 27	Mounting bracket.
SA - 27	12" antenna.
LC - 18	Carrying case.
CC-51	RCA phono-to-clip lead cable (supplied.)
UP-27	Operating pack for 1827. Consists of one each of: BC-27, MB-27, SA-10, SA-12 and SA-27.

OPERATING PROCEDURE

A. CONTROLS AND FEATURES

1. **FUNCTION SWITCH.** Turns instrument on and selects preset (1 SEC) or AUTO counting range. In the AUTO range mode, proper gate interval is automatically selected by the instrument to fill all six digits, starting with the most significant digit, without overflow (also referred to as "overrange").
2. **INPUT JACK.** Phone type jack. 10 KΩ impedance.
3. **KHz FREQUENCY UNIT INDICATOR.** Indicates that the decimal point is placed to read measured frequency in kHz. This indicator is always on when the function switch is in the 1 SEC position, and the decimal point is as shown in Fig. 2.
4. **MHz FREQUENCY UNIT INDICATOR.** Indicates that decimal point is placed to read measured frequency in MHz.
5. **NUMERICAL DISPLAY.** Indicates frequency of the input signal.
6. **OVERRANGE INDICATOR.** Flashes when the frequency is beyond the selected display range.
7. **DISPLAY PUSHBUTTON.** Restores display blanked by automatic power saver feature. Allows display to remain on 10 seconds after button is released. Not used when external power is obtained from BC-27 adapter or other available external power options.

B. INTERPRETATION OF DISPLAY READINGS

For purposes of identification, the six display digits of the counter will be identified numerically as shown in the display of Fig. 2.

Digit #1 is to the extreme right and digit # 6 is to the extreme left. In addition, the most significant digits (MSD) and least significant digits (LSD) are indicated.

When the function switch is in the 1 SEC position, the decimal point is located as shown in Fig. 2 and the kHz lamp is lit. All readings are then indicated in kiloHertz. For example, if a frequency of 654,321 Hz is to be measured, the display would be as shown in Fig. 3. With the function switch still in the 1 SEC position, a measurement of 321 Hz would be displayed as shown in Fig. 4. Note that the unused digits register as zeros and the decimal point is retained in the kiloHertz position. The reading is displayed as 000.321 kHz, which is actually 321 Hz.

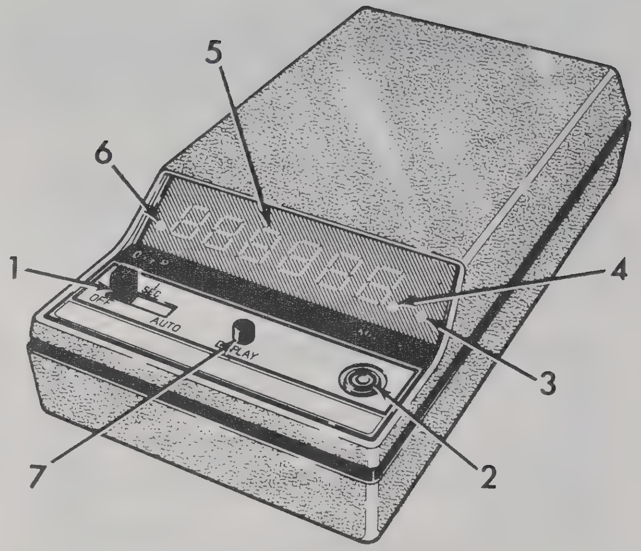

Fig. 1. Controls and features.

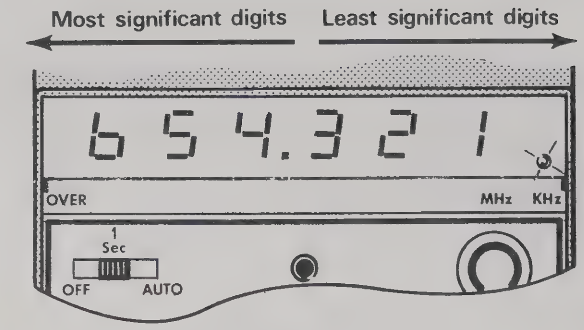

Fig. 2.

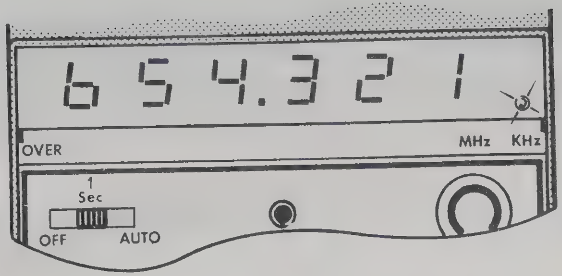

Fig. 3.

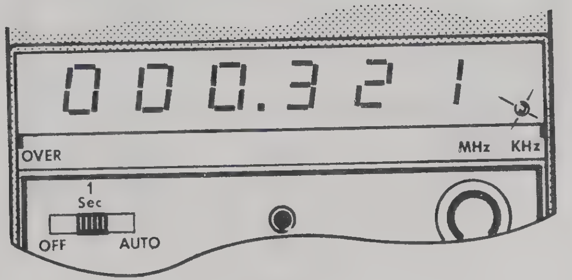

Fig. 4.

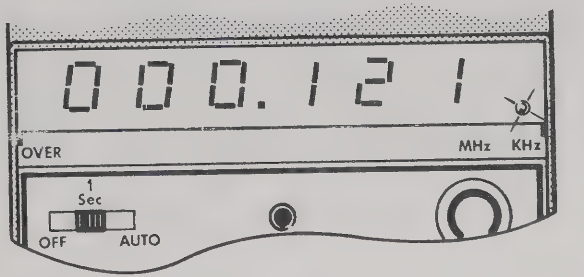

Fig. 5.

If a frequency of 121 Hz is measured, the display would read as shown in Fig. 5, which is 000.121 kHz. It should be noted here that as fewer digits are displayed, the accuracy of the reading decreases, because of the uncertainty of the last digit. With a tolerance of ±1 count on the reading displayed, a frequency of 121 Hz actually may be displayed as 120, 121 or 122 Hz.

With the function switch in the 1 SEC position, and with the reading greater than 1 MHz (for example, 1,654,321 Hz), only the last six digits of the frequency being measured will be indicated, as shown in Fig. 6. Note that the kHz lamp is lit and that the OVER lamp is flashing. This indicates that the most significant digit is not being displayed in the frequency count.

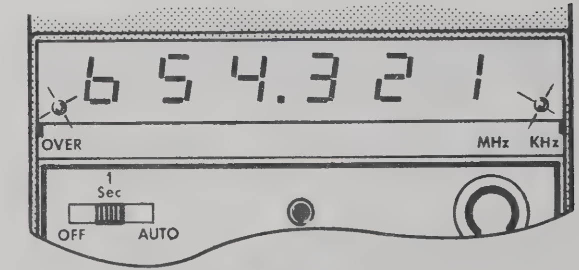

Fig. 6.

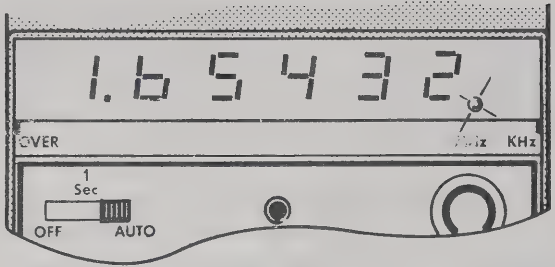

Fig. 7.

Maximum resolution to the Hz is obtained under these conditions because the least significant digit is displayed; however, the first and most significant digit cannot be determined.

When the condition described above occurs, the function switch should be placed in the AUTO position. The display corresponding to measurement of the frequency 1,654,321 Hz would then appear as shown in Fig. 7.

Note that the MHz lamp is now lit and that the least significant digit (1) is no longer being displayed at the right end of the display, and the most significant digit (1) has been added at the left end of the display. When the most significant digit is displayed, the OVER lamp is off.

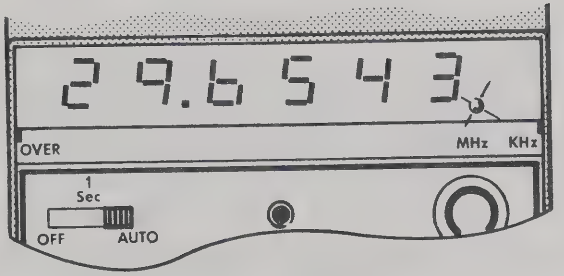

Fig. 8.

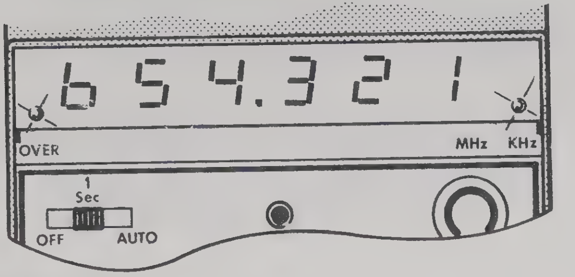

Fig. 9.

Now consider the case in which a measurement is to be performed at 29.654321 MHz. With the function switch in AUTO position, the frequency reading will be displayed as shown in Fig. 8. Notice that the two least significant digits (2 and 1) have been deleted. Also, the MHz lamp is lit, indicating the reading is displayed in MegaHertz. Because the most significant digits (2 and 9) are displayed, the OVER light is not lit. If it is desired to obtain maximum resolution of the frequency being measured (in other words, down to the Hertz), the function switch must be placed in the 1 SEC position. The reading will be displayed as shown in Fig. 9.

Notice that the least significant digits (2 and 1) are displayed and that the most significant digits (2 and 9) are *not* displayed. Because the most significant digits are not displayed, the OVER lamp will flash, indicating that the actual frequency being measured is *greater* than that displayed.

Remember that with the function switch in the AUTO position, the most significant digits are always displayed and the kHz or MHz light will be on as required to identify the units of measurement. For example, with the function switch in the AUTO position, and with a measurement of 321 Hz, the display of Fig. 4 is automatically obtained.

For maximum convenience of operation, the AUTO position of the function switch should be used. However, when it is desired to have the maximum resolution of the reading (to the Hertz) the 1 SEC position is selected.

Bear in mind that the least significant digits of the measured frequency displayed will *change as the reading is being observed,* the amount depending on the frequency stability of the frequency source being measured. An oscillator with the inductance and capacitance as frequency-determining elements may have a rather fast rate of change, while a crystal-controlled oscillator will provide a much more stable frequency reading.

C. AC-POWERED CHARGER/ADAPTER USE

Optional accessory Model BC-27 is recommended. The charger/adapter is designed for use with "AA" size Ni-Cad batteries (BP-27 Battery Pack available). It plugs into the power jack at rear of your frequency counter. Note that the slide switch on the charger/adapter must be in the proper position for either Ni-Cad or Carbon-Zinc/Alkaline battery operation.

D. BATTERY OPERATION WITH NON-RECHARGEABLE BATTERIES OR NI-CAD RECHARGEABLES

Your frequency counter will operate from 6 "AA" size batteries, rechargeable or non-rechargeables. Install as shown under BATTERY REPLACEMENT AND INSTALLATION.

E. DC-POWERED OPERATION

Your frequency counter can receive its power through your automotive cigarette lighter when you use the SA-12 Automotive Power Cord (see OPTIONAL ACCESSORIES), for 12 volt operation only. Also, an external 6.7 to 9.7 volt DC supply can operate your counter by using the power cord accessory CC-52.

F. USING YOUR FREQUENCY COUNTER

CAUTION

Before you proceed with this section, carefully read the specifications. Damage to the instrument can result if excessive voltage is applied to the input jack or power jack. Be sure the signal is within the parameters specified for this instrument.

NOTES

At high frequencies, always terminate the transmission line in its characteristic impedance (e.g., 50-ohm coaxial cable should be terminated into a 50-ohm resistive load). This will eliminate reflections along the line which could damage the equipment under test, or produce inaccurate readings. A DC blocking capacitor is required in those cases where the circuit DC bias might be affected by the termination resistor.

Proceed as follows:

1. Turn on your frequency counter by setting the function switch to either 1 SEC or AUTO range.
2. Connect the signal to be counted to the input jack.
3. If the display overranges in the 1 SEC range, switch to AUTO and read the frequency directly in MHz. When in the AUTO mode, allow the unit enough time to select the proper range and display the frequency. For frequencies below 1 MHz, the AUTO mode will select the 1-second time base and the frequency readings will be displayed in kHz.
4. In the 1 SEC range, the display shows the reading to Hertz (least significant digit, LSD), even though the most significant digits (MSD) may be beyond the display reading (overrange indicator flashes). Example: If measuring a frequency of 10.654321 MHz, the counter will display 10.6543 MHz if it is in AUTO mode, and display "Over 654.321 kHz" if it is in 1 SEC range.

G. APPLICATIONS

1. Radio Transmitter Frequency Measurement.

Four watts output power is chosen as an example. Refer to Fig. 10 for details.

a. If a commercial 50-ohm termination, such as the Bird Model 6154, is not available, use a 5W, 50-ohm, non-inductive resistor at the transmitter output as a dummy load in order to protect the output stage.

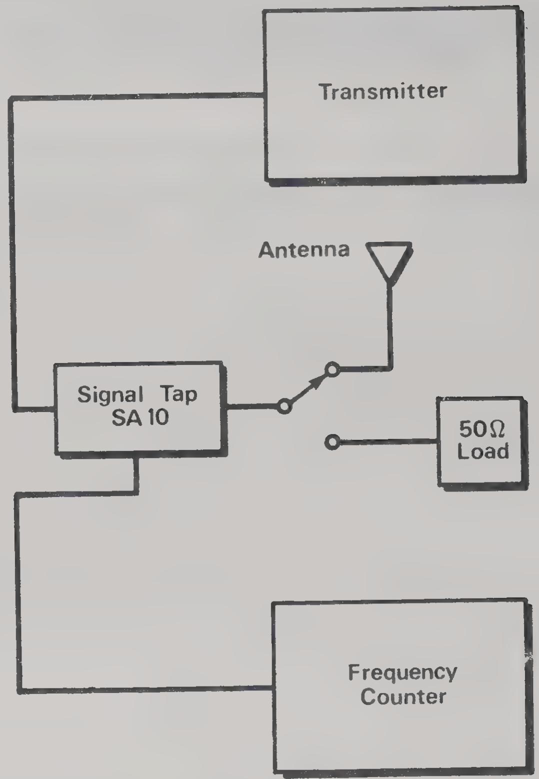

Fig. 10. Measuring transmitter frequency.

b. A signal tap, such as the SA-10 (see "OPTIONAL ACCESSORIES"), is used in a 50-ohm coaxial cable to protect the transmitter output stage from load mismatch and to protect the counter input stage from excessive signal voltage. To determine the peak voltage of an RF carrier when the power and load are known, use the relationship:

$E\ PEAK = 1.4\sqrt{PR}$ where

P is power output in watts, and

R is load resistance in ohms.

Using a 4-watt output into 50 ohms,

$$\begin{aligned} E\ PEAK &= 1.4\sqrt{4 \times 50} \\ &= 20 \text{ volts} \end{aligned}$$

If we consider that this value can almost double with 100 percent modulation and can be multiplied several times again by severe load mismatches, the importance of minimizing the voltage to the counter becomes obvious.

c. Without using a signal tap, or any external hook-ups, the optional Antenna, SA-27, can pick up the transmitted frequency within approximately 6 feet of the transmitting antenna at 27 MHz. **NOTE:** For automotive dash or service bench mounting of your frequency counter, the optional mounting bracket, MB-27, is recommended. This versatile bracket allows you to mount the counter either on top of or below your automobile dash or service bench shelf. Complete installation instructions are included with each bracket.

2. Amplitude-Modulated Signals.

Erroneous frequency readings may be obtained if carrier frequency measurements are performed with a high percentage of amplitude modulation present. This is caused by the fact that the carrier level periodically decreases to a near zero amplitude at 100% modulation. If this modulated signal is applied to the frequency counter through a signal tap as outlined earlier, the possibility of the carrier level dropping to a value lower than the counter sensitivity must be considered. When this occurs, the counter does not count during the entire interval and an erratic and inaccurate reading results. For more reliable results, the amplitude modulation should be removed when carrier frequency measurements are performed.

The frequency of the modulating signal, if in the audio range, can be measured if a suitable detector with low-pass filter is used between the signal test point and counter.

3. Square Wave or Pulse Train Measurement.

In some cases, miscounts can occur when measuring the frequency of square waves or a pulse train, particularly if an unterminated input cable is used. That error is caused by "ringing" or overshooting in the unterminated transmission cable. A damping resistor in series with the cable signal line can eliminate this effect. For example, a 91KΩ series resistor will give you 10X attenuation, giving a total equivalent load impedance of 100KΩ.

In practically all cases where the output of a pulse or square wave generator is being measured, satisfactory results are obtained if a short cable is used with a terminating resistor at the counter input which matches the generator impedance.

4. VHF/UHF Frequency Measurement.

Your frequency counter is compatible with all commercially available prescalers to extend the frequency range up to the UHF range (with 100:1 prescaling).

THEORY OF OPERATION

Your frequency counter consists of an input section, time base circuit, counter section, display, and power supply circuitry.

1. INPUT

The input circuit consists of a protected differential amplifier (IC1) and PNP output stage (Q1) with Schmitt-trigger and count control circuitry (IC8).

2. TIME BASE

A precision 4 MHz oscillator serves as the timing control for the complex internal timing generated by the custom L.S.I. Integrated Circuit, IC3.

3. COUNTER SECTION

The two divide-by-ten counters (IC2,7) and the custom L.S.I. Integrated Circuit (IC3) serve as the complete counting circuit.

4. DISPLAY

Multiplexed BCD signals from the counter chain internal to IC3 are decoded through IC101, which drives the 7-segment displays. IC4 provides the current sinking needed for the digit strobing and IC5 provides necessary drives to the decimal points and kHz/MHz indicators.

5. POWER SUPPLY

Wide voltage operation (6 to 9V) requires two regulating transistors (Q3,5) to keep the voltage within a limited range for certain IC's.

NOTES

RECALIBRATION AND MAINTENANCE

Your counter was carefully checked and calibrated at the factory prior to shipment. There are three adjustments in all the circuitry, so recalibration is not difficult, if it is ever required.

Calibration of this instrument should not be attempted unless you are experienced and qualified in the use of precision laboratory equipment. Should any difficulty occur during repair or calibration, refer to the warranty service instructions at the rear of this manual for information on technical assistance.

Location of adjustment points are shown in Fig. 11. Access to the printed circuit board is the same as for battery replacement.

To calibrate the oscillator, a 10 MHz standard with accuracy of at least ±1 part in 10^8 is required to set the oscillator ±1 Hz of 10 MHz (a 1 MHz standard can be used to set the oscillator ±10 Hz of 10 MHz).

PROCEDURE:

1. Adjust R9 so that the emitter of Q5 measures 4.75 volts with 6 volts applied at the collector of Q5.
2. Adjust R24 so that Pin 1 of IC8 measures 2 volts with 6 volts applied at the collector of Q5 and no input signal.
3. Place unit at room ambient temperature, unless a more specific temperature is required for the temperature at which your frequency counter is most often used. See "SPECIFICATIONS" for frequency stability.
4. Connect the standard frequency source to the input jack.
5. Operate unit near the center of the voltage operating range (7.5 volts) or use optional AC adapter BC-27. See "OPTIONAL ACCESSORIES."
6. Set function switch to 1 SEC position.

   The instrument will overrange and the most significant digits will be lost.

7. With a non-metallic alignment tool, adjust C12 for display reading equal to the standard frequency ±1 count.

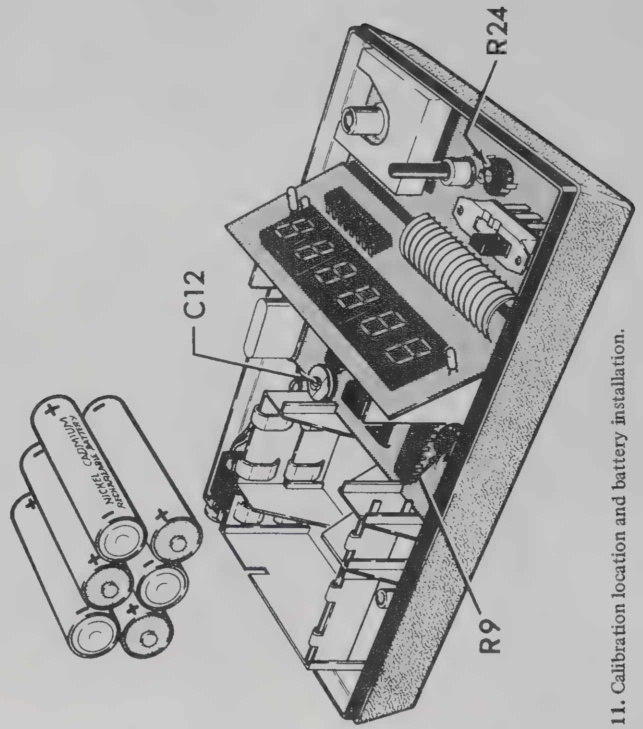

Fig. 11. Calibration location and battery installation.

BATTERY REPLACEMENT AND INSTALLATION

Remove the 4 screws at the bottom of the case and remove the top cover from your frequency counter. Observe proper polarity when installing new batteries. See Fig. 11. If alkaline or carbon-zinc type batteries are being used, they should be removed immediately when expended to prevent instrument damage from battery leakage.

PENLIGHT SIZE "AA" BATTERIES

Type	Neda	Burgess	Eveready	Mallory	RCA	Ray-O-Vac
Carbon-Zinc	15	930	1015	M15R	VS 334	15
Alkaline	15A	AL9	E91	Mn1500	VS1334	815

RECHARGEABLE TYPES

Type	G.E.	Gould	Eveready
Ni-Cad	GCE450SB	500SC	CH500

CB CHANNEL FREQUENCY ALLOCATIONS

CHANNEL	FREQUENCY	CHANNEL	FREQUENCY
1	26.965	21	27.215
2	26.975	22	27.225
3	26.985	23	27.255
4	27.005	24	27.235
5	27.015	25	27.245
6	27.025	26	27.265
7	27.035	27	27.275
8	27.055	28	27.285
9	27.065	29	27.295
10	27.075	30	27.305
11	27.085	31	27.315
12	27.105	32	27.325
13	27.115	33	27.335
14	27.125	34	23.345
15	27.135	35	27.355
16	27.155	36	27.365
17	27.165	37	27.375
18	27.175	38	27.385
19	27.185	39	27.395
20	27.205	40	27.405

DYNASCAN CORPORATION
1801 West Belle Plaine Avenue, Chicago, Illinois 60613

INSTRUCTION
MANUAL

B&K Model 290

EXTENDED-RANGE
SOLID-STATE
ELECTRONIC MULTIMETER

B&K
Product of DYNASCAN CORPORATION

Dear Friend:

Congratulations on your purchase of B & K—Precision Test Equipment, and welcome to the B & K family. We hope your experience with your new test equipment will make you a lifetime B & K customer.

Your instrument is backed by more than 20 years of experience in designing and manufacturing. Our most important goal is your satisfaction. At B & K, test ment is made to meet the demands of the field focusing on dependability ccuracy. We also concentrate on simplicity and operating ease with es that reduce the possibility of human error and speed the servicing ss.

rder to determine the type of test units that are needed we have been d by letters and reports from technicians and engineers who use the ment daily. Our field tests and studies have helped provide better and service techniques. Close contact has been maintained with the manu- ers of consumer products which our test units will be checking and le-shooting.

personnel in our company cut their eye teeth in the TV service business. s why we have more "sensitivity" for the problems and conditions under the test equipment will be used.

K product designs are constantly reviewed, and refinements are made w models developed to meet advances in our industry and to fill your s. We set our standards high so you can be assured that the B & K test ments you buy represent advanced design, quality construction, and ndable long-term performance at a price you can afford.

ou have any comments or thoughts about our products, or test equipment neral, I would be delighted to hear from you.

anks for your confidence in B & K and we look forward to serving you for g time to come.

Sincerely,

Carl K

Carl Korn
President

INSTRUCTION MANUAL

FOR

Model 290

EXTENDED-RANGE,
AC-OPERATED
SOLID-STATE
ELECTRONIC MULTIMETER

B & K *DIVISION OF DYNASCAN CORPORATION*
1801 West Belle Plaine Avenue
Chicago, Illinois 60613

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GENERAL DESCRIPTION AND SPECIAL FEATURES

The B & K Model 290 is a solid state FET input Electronic Multimeter ideally suited for radio and TV service technicians, industrial users, engineers and hobbyists.

Its main features include:

- High input impedance (15 megohms) on both AC and DC voltage measurements for minimum circuit loading.
- 50 millivolts full-scale sensitivity on both AC and DC volts.
- Special low resistance ohms range (one ohm center scale).
- Low voltage and normal voltage ohms tests for measuring resistances or for testing IC's, transistors, SCR's, etc. in or out-of circuit.
- Full AC operation (no batteries) with regulated power supplies for ultra stable operation.
- Protection from accidental overloads to meter, FET's and other circuit elements.
- Easy-to-read meter with mirrored scale for making exact measurements.

SPECIFICATIONS

DC VOLTS:	
10 Ranges:	50mV, 150mV, 500mV, 1.5V, 5V, 15V, 50V, 150V, 500V and 1500V full scale.
Accuracy:	± 1.5% full scale.
Input Resistance:	15 Megohms, ± 1.5% including 100K isolating resistor in probe.
Normal Mode Rejection:	Better than 46 dB @ 60 Hz for ± 2% accuracy change
AC VOLTS:	
10 RMS Ranges:	50mV, 150mV, 500mV, 1.5V, 5V, 15V, 50V, 150V, 500V and 1500V full scale.
10 Peak-to-Peak Ranges:	140mV, 440mV, 1.4V, 4.4V, 14V, 44V, 140V, 440V, 1400V and 4400V full scale.
Input Impedance:	14.9 Megohms shunted by approximately 41pf at input jacks. (140pf with PR-21 Probe).
Frequency Response:	±.5dB, 20Hz to 500kHz to 150V ± 3dB, 5Hz to 750kHz to 150V ± 3dB, 5Hz to 20kHz over 150V
Accuracy:	± 3% full scale @ 60Hz, ± 5% on 500V and 1500V ranges.
Common Mode Rejection:	Better than 40 dB @ 60Hz.

OHMS MEASUREMENT:

8 Low Voltage Ranges (33mV):	RX0.1, RX1, RX10, RX100, RX1K, RX10K, RX100K, RX1M.
7 Normal Voltage Ranges (1.25V):	RX1, RX10, RX100, RX1K, RX10K, RX100K, RX1M.
Midscale Reading:	10 (times multiplier)
Accuracy:	±3° of arc, (±4° of arc on RX0.1 and RX1M ranges).

DC CURRENT:

10 Ranges:	50μA, 150μA, 500μA, 1.5mA, 5mA, 15mA, 50mA, 150mA, 500mA and 1.5 Amp full scale.
Accuracy:	± 3% full scale; ± 4% on 1.5 Amp Range.
Internal Voltage Drop:	50mV at instrument input terminals, to 50mA range.

AC CURRENT:

10 Ranges:	50μA, 150μA, 500μA, 1.5mA, 5mA, 15mA, 50mA, 150mA, 500mA, and 1.5 Amp full scale.
Accuracy:	± 4% full scale @ 60Hz, ± 5% on 50μA and 1.5 amp ranges.
Internal Voltage Drop:	50mV, at instrument input terminals, to 50mA range.
Frequency Response:	±.5dB, 20Hz to 5kHz, 500uA to 150mA ranges. ±3dB, 7Hz to 16kHz, 500uA to 150mA ranges.

DECIBEL (dB):

10 Ranges:	–40 to +66.
Accuracy:	± 3% of full scale.
Reference:	1mW into 600 ohms. (.775V)

RESISTORS:

Multipliers :	½% Precision Type – Frequency-compensated.
Current Shunts:	1% Precision Type
Ohms Shunts :	2% Precision Type

METER:	7", 100μA, ± 2%, 100°. DC zero center scale. Mirrored scale.
PROTECTION:	Meter and FET input protected by diode from overloads. Circuit overload protection by fuse (1.25 Amp). High Voltage protection by spark gaps. Power line fuse: 1/16 amp, 3AGSB.
SEMICONDUCTORS:	(1) Dual N-Channel FET. (1) NPN Dual Transistor. (1) NPN Signal Transistor. (1) NPN Low Power Transistor. (2) Germanium Diodes. (2) Silicon Diodes. (4) Silicon Rectifiers (2) Zener Diodes.
POWER REQUIREMENTS:	105 – 125 VAC, 50/60Hz; 3.9 Watts.
DIMENSIONS:	7-1/4" H. x 8" W. x 3-5/8" D.
WEIGHT:	4-1/4 lbs.

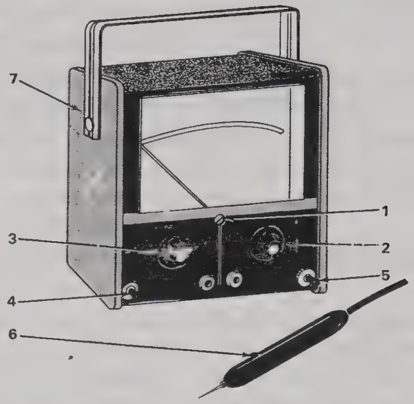


Figure 1. Operating Controls

OPERATING CONTROLS

This Electronic Multimeter is as simple to operate as a conventional VTVM. The llowing is a brief description of each control and how it is used (refer to Figure

1. METER ZERO ADJUST (MECHANICAL): The mechanical meter zero adjustment must be made before the instrument is turned on. Insert a screwdriver (preferably non-metallic) into the slot located in the center of the front panel immediately below the meter face. While gently tapping meter, very slowly turn the mechanical zero adjust until the pointer rests at zero.
2. FUNCTION SWITCH: Used to select the desired function for the measurements to be performed.
3. RANGE SWITCH: Used to select the desired range of current, voltage, or resistance to be measured.
4. OFF-ON SWITCH AND ZERO CONTROL: To turn the meter on, pull the ZERO control shaft outward. The red lamp on the meter will glow, indicating the meter is ON. Rotate the ZERO control to position the pointer of the meter at zero on the meter scale or to position the pointer on the zero center when using this feature. Push the ZERO control shaft in to turn the meter OFF.
5. OHMS CONTROL: The OHMS control is adjusted with the FUNCTION switch in one of the OHMS positions and with the test leads open. Rotate the OHMS control for a full scale indication, infinity (∞) on the ohms scale of the meter.
6. PROBE SWITCH: This instrument is equipped with a shielded test lead to allow accurate AC measurements in the presence of strong electrical fields. When the switch is in the 100K position, a 100K resistor is switched in series with the test lead. This isolates the cable capacity from the circuit under test when making DC voltage measurements in RF, IF or sweep circuits. Set the probe switch to the DIRECT position for all measurements other than DC voltage.
7. ADJUSTABLE HANDLE: The carrying handle may be used to support the instrument in a convenient sloping position for easy viewing. The case also can be placed in either a vertical or horizontal position.

OPERATING THE MODEL 290

SAFETY PRECAUTIONS

A certain amount of danger is always present when working on electrical equipment and therefore, the user is cautioned to always familiarize himself as much as possible with the equipment to be tested, before any work is performed. It should be kept in mind that high voltages often appear at unexpected points in defective equipment.

When testing high voltage circuits, develop the habit of keeping one hand in your pocket to minimize the hazard of accidental shock. It is also important to have a properly insulated floor or floor covering to stand on while taking measurements. Be particularly careful to avoid contacting nearby objects which could provide a ground return path. A good practice is to remove operating power before connecting test leads. AN ISOLATION TRANSFORMER SHOULD ALWAYS BE USED IN EQUIPMENT HAVING THE CHASSIS TIED TO ONE SIDE OF THE A-C POWER LINE.

1. PREPARATION FOR MAKING MEASUREMENTS:
   a. With the ZERO control knob pushed in (meter in the OFF position), check to see that the meter pointer rests over the zero mark on the left side of the scale. If the pointer is off zero, reset the meter zero adjust (mechanical, as explained under OPERATING CONTROLS).
   b. Insert the double banana plug of the test lead assembly into the meter terminal receptacles so that the positive (+) pin of the plug is in the red (+) terminal.
2. MEASURING DC VOLTAGES:
   a. Turn the FUNCTION switch to the –DC V or +DC V position, depending on the polarity of the voltage to be measured.
   b. Set the PROBE switch to 100K.
   c. Pull the ZERO control shaft outward and rotate ZERO control until meter pointer rests over the zero mark on VOLTS/MA scale.
   d. When measuring an unknown voltage, set the RANGE switch fully clockwise.
   e. Connect the black (negative) lead of the test lead assembly to ground or reference point of the circuit under test. Bring the probe tip in contact with the point to be measured.
   f. Observe the instrument reading; if the meter pointer deflects to the left, set the FUNCTION switch to the correct polarity.
   g. The DC voltage is read on the two black scales just above the mirrored scale on the meter. The top DC scale is used with the 50mV, 500mV, 5V, 50V and 500 Volt ranges. The second DC scale is used for the 150mV, 1.5V, 15V, 150V and 1500 volt ranges. The 0 to .5 volt scale is read directly for the .5 volt range, and is multiplied by .1, 10, 100 and 1000 for the 50mV, 5V, 50V and 500V ranges respectively. The 0 to 1.5 volt scale is read directly for the 1.5 volt range and multiplied by .1, 10, 100 and 1000 for the 150mV, 15V, 150V and 1500 volt ranges respectively.
3. ZERO CENTER DC VOLTAGES:
   a. Set the FUNCTION switch to +DC V and short the test leads together.
   b. Rotate the ZERO control knob clockwise until the meter pointer rests over the center zero mark (the bottom scale).
   c. Set the PROBE switch to 100K.

d. Set the RANGE selector switch fully clockwise and connect the test leads to the circuit the same as for DC voltage measurement.

e. Observe the meter pointer indication on the black scale marked "O" and rotate the RANGE switch counterclockwise to obtain the best useable meter deflection. Positive voltages will make the pointer deflect to the right of the center zero mark. Each side of the scale represents one-half of the range being used. For example, when the .5 volt range is being used, each half of the scale represents .25 volt and each division .01 volt. The purpose for the center zero scale is to indicate a balanced condition. For example, if this instrument is used in the alignment of an FM discriminator, the desired balanced condition will result in a reading of zero on the meter. A misaligned condition will cause some deflection in either the positive or negative direction.

4. MEASURING AC VOLTAGES (RMS & P-P):

NOTE

Effect of waveform in measuring AC voltages: This instrument employs a peak-to-peak type detector, and is calibrated using a sinusoidal signal. The scale is calibrated to give RMS readings, using effective values based on a true sinewave. When it is known that other than sinusoidal signals are being used, it must be recognized that the accuracy as specified for sinusoidal waveforms will not apply. However, peak-to-peak values will remain accurate using the peak-to-peak scales on the meter.

a. Set the FUNCTION switch to the AC V position.

b. Set the PROBE switch to DIRECT.

c. Set the RANGE switch to the desired position. If the voltage is not known, set RANGE switch fully clockwise.

d. Short test leads together and rotate ZERO control until meter pointer rests over zero mark on VOLTS/MA scale.

e. Connect the black (negative) lead of the test lead assembly to the chassis or reference point of the circuit under test.

f. Bring the tip of the probe in contact with the point in the circuit where the voltage is to be measured.

g. Observe the meter indication. RMS voltage is read on the two red scales just below the mirrored scale on the meter. To measure peak-to-peak voltage, the two red scales marked VOLTS P-P are used. The scale readings are multiplied by the same multiplier factors as were used in DC voltage measurements.

5. dB MEASUREMENTS:

The dB scale (−10dB to +6dB) for measuring output level is calibrated according to the standard of 1mW into 600 ohms and direct scale readings apply with the RANGE switch in the 1.5V position (0dBm). The ten AC V ranges are in 10dB steps, so that starting from "OdB" on the 1.5V range, add 10dB for each range above 1.5 volts and subtract 10dB for each range below 1.5 volts. All dB measurements are a measure of the ratio between the voltage in the circuit under test and the standard reference level indicated above. If the impedance across which the measurement is taken is other than 600 ohms, use Figure 2 to determine actual power level with respect to 600 ohm reference. The chart in Figure 3 can be used to determine the power being dissipated in a circuit if the circuit impedance along with either the applied voltage, or the dB is known. This chart also shows the relationship of AC volts to dB.

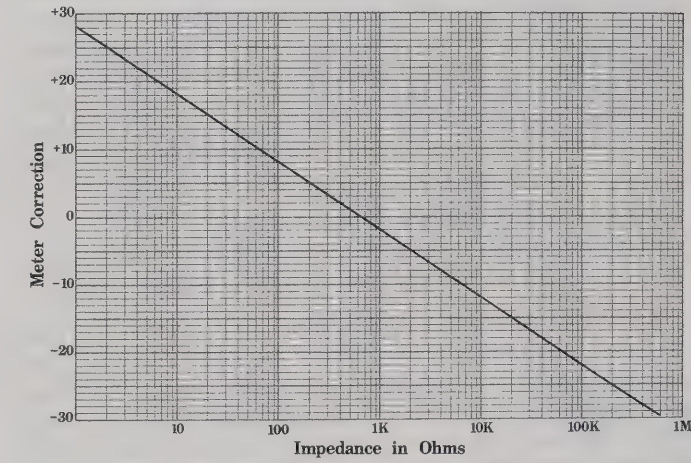


Figure 2. DB Correction Chart

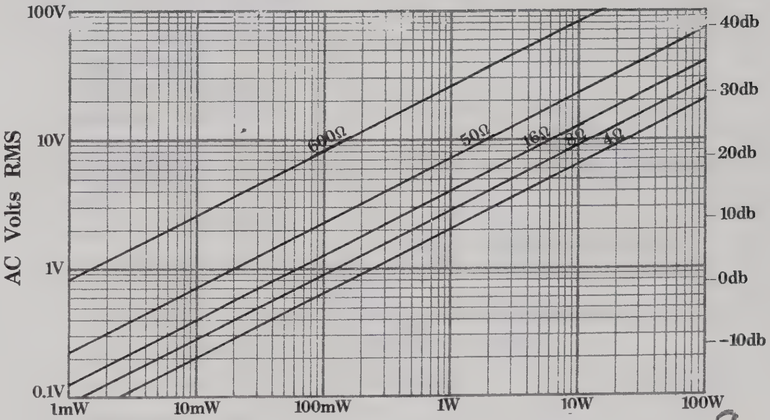


Figure 3. Voltage vs. Power Chart (Sine Wave Conditions Only)

NOTE

The dB scales of this meter and the charts in Figure 2 and Figure 3 only apply when the voltage being measured is a pure sine wave. Complex waveforms such as those encountered in music material will not give a true RMS reading for the dB system to be accurate, however, the dB scales can be used for relative level measurements.

EASURING RESISTANCES:

CAUTION

When making resistance measurements be sure that the power to the equipment under test is disconnected. If voltage is accidentally applied to the ohms ranges, fuse replacement may become necessary.

i Ohms Measurements. To measure resistance, set the FUNCTION switch to he HI OHMS position, and the RANGE switch to the range that will put the esistance to be measured as close to the center of meter scale as possible. hen the FUNCTION switch is placed in the OHMS functions, the meter ointer will move from the left hand edge of the meter (zero) to the infinity ∞) mark on the right hand side of the meter. Short test leads together and otate ZERO control until meter pointer rests over zero mark on ohms scale. emove short from test leads and rotate the OHMS control to adjust the neter pointer to exactly the infinity (∞) mark on the right hand side of the neter. Be sure that the probe switch is in the DIRECT position. When using he HI OHMS function in solid state circuits, the applied 1.25 volts will be igh enough to cause diodes or transistors to conduct. On all resistance anges, the probe tip is positive with respect to the minus (–) test lead. Remember this when checking components which have a different forward and reverse resistance such as semiconductors and electrolytic capacitors.

Checking for Triggering of Low-Power Silicon-Controlled Rectifiers (SCR): Low-power SCR's can be checked to see if they can be triggered to the ON condition. To make this check, proceed as follows:

(1) Set the FUNCTION switch to HI OHMS and the RANGE switch to RX1.

(2) Adjust OHMS control so meter reads full scale (∞).

(3) Set the PROBE switch to the DIRECT position.

(4) Connect Minus (–) test lead to the cathode of the SCR and the Plus (+) test lead to the anode.

(5) If the SCR is good, the meter will continue to read ∞. Now momentarily short the SCR gate lead to anode lead. The meter should read a very low resistance, indicating that the SCR has been triggered and is conducting. Removing voltage from the anode lead of the SCR will return it to the non-conducting condition.

Lo Ohms Measurements. The LO OHMS function is used to make resistance measurements in solid state circuits when the forward conduction of a diode or transistor junction can cause an objectionable error. When using this function, only 33 millivolts (.033 volt) is applied to the circuit being measured (42 millivolts on RX0.1 Range). This is well below the conduction threshold of silicon and germanium semiconductor junctions. The resistances measured with this instrument in the LO OHMS function will only be the resistance of the circuit components connected to the transistor or diode, and will not be affected by the semiconductor device.

NOTE

The following checks can be made on IC's using the HI-LO OHMS functions of this instrument:

The resistor values within the IC can be measured using the LO power ohms function to determine if the resistor values have changed due to overloads. Transistors and diodes within the IC can be checked for leakage using the LO power ohms function and a high resistance range such as RX1 meg. Substrate leakage of an IC can be checked by using a high resistance range such as RX1 meg and the HI power ohms function. Front-to-back ratio of transistors and diodes can be measured by using the HI power ohms function and reversing the test leads.

NOTE

If the transistor or diode within the IC is shunted by resistances, the highest of the two readings taken (by reversing the test leads) is the equivalent resistance value of the resistors within the IC.

Many other measurements can be made if a schematic diagram of the IC is used.

d. **Very Low Resistance Measurements:** Very low resistance measurements without damage to semiconductors or components can be made using the RX0.1 LO OHMS range. Only 42 millivolts is applied to any device under test on this range. Uses for this resistance range are many. Some typical applications are listed below:

Resistance wire measurements.
Coil windings.
Transformer windings.
Wirewound resistors.
Switch contact resistance.
Cold resistance of lamps.
Fuses.
Heavy wire measurements.

To make resistance measurements on this range proceed as follows:

NOTE

Do not use test leads for making resistance measurements on this range, as an error in readings will result.

(1) Set the FUNCTION switch to LO OHMS.

(2) Set the RANGE switch to RX0.1.

(3) Connect a short heavy gauge wire between the plus and minus jacks and adjust ZERO control until pointer rests exactly over zero mark on OHMS scale.

(4) Remove short from test jacks. The meter pointer will move from the left hand edge of the meter (Zero) toward the infinity (∞) mark on the right hand side of the meter. Rotate the OHMS control to adjust the meter pointer to exactly the infinity mark.

(5) Repeat ZERO and OHMS adjustments at least one more time to obtain the best accuracy.

(6) Make solid connections between test jacks and device being measured and read resistance on OHMS scale (if device has no leads, use short heavy gauge wire).

(7) Multiply resistance reading by 0.1. For example, if the meter reads 10 ohms (center scale) the resistance being measured will be 10 x 0.1 = 1 ohm.

NOTE

It will be necessary to readjust the OHMS and ZERO controls when returning to the higher Ohms ranges.

e. **Measuring Resistance of Thermistors:** The LO OHMS function should be used for making accurate measurements of resistances of thermistors of low resistance value. If this measurement is made in the HI OHMS function, a changing resistance reading will result due to heating caused by the higher current flow through the thermistor. The thermistor should not be held in the hand and should be kept away from any other heat to obtain the most accurate resistance indication.

MEASURING AC CURRENT:

a. Set the FUNCTION switch to the AC A position.

b. Set the PROBE switch to DIRECT.

c. Short test leads together and rotate ZERO control until meter pointer rests over zero mark on VOLTS/MA scale.

d. Set RANGE switch to the desired range. If the approximate value of current flowing within the circuit is not known, set the RANGE switch to the 1.5A position and work down toward the 50μA range until an accurate reading is obtained.

e. Turn the power to the equipment under test OFF and open the circuit in which you wish to measure current flow. Connect the ground lead of the test lead assembly to one side of the circuit. Connect the tip of the probe to the other side of the circuit under test.

f. Turn the power to the equipment under test ON and observe the meter pointer deflection. Set the RANGE switch to obtain the most accurate indication (nearest to full scale). AC current is read on the two red scales just below the mirror scale on the meter.

8. MEASURING DC CURRENT:

a. Set the FUNCTION switch to DC A.

b. Set the PROBE switch to DIRECT position

c. Short test leads together and rotate ZERO control until pointer rests over zero mark on VOLTS/MA scale.

d. Set the RANGE switch to the range desired. If the approximate value of current flowing within the circuit is not known, turn the RANGE switch to the 1.5A position and work down toward the 50μA range until an accurate reading is obtained.

e. Open the circuit in which you wish to measure current flow. Make sure that meter is inserted in series with the load in which the current is being measured. Do not connect the meter in parallel with the voltage source connected to the load. A severe current overload will blow the fuse. Connect the ground lead of the test lead assembly to the negative side of the circuit. Connect the tip of the probe to the positive side of the circuit under test.

f. Turn the power on in the circuit under test. Observe the meter pointer deflection. If the pointer is deflected to the left the current polarity is opposite of that which was anticipated. Reverse the test leads and the meter will read up scale. DC current is read on the two black scales just above the mirror scale on the meter.

9. MEASURING DC CURRENTS BELOW 50μA: Reverse leakage current of transistors or diodes can be measured accurately with this instrument at the specified reverse voltage for the device. To make this measurement connect a 100,000 ohms, 5% or better precision resistor across the instrument input terminals. Connect diode or transistor in series with the positive (+) lead and an external power supply voltage. Connect negative (–) lead to minus on power supply.

NOTE

Diode or transistor must be connected in the reverse direction to make a reverse leakage measurement.

Set the FUNCTION switch to +DC V position and the RANGE switch to 1.5V/MA. Increase voltage from the external supply to that specified for the device to be tested. Read leakage current on the two black scales just above the mirrored scale on the meter. Full scale indications are as follows:

Range Switch Position	Full Scale DC Current
1.5V/mA	15μA
500mV/mA	5μA
150mV/mA	1.5μA
50mV/mA	.5μA

NOTE

When measuring current higher than 1.25 Amps, limit measurement time to less than 5 minutes, or fuse replacement may become necessary.

CALIBRATION AND MAINTENANCE

The calibration, bias and balance adjustments have been carefully and accurately adjusted at the factory, and they should not require readjustment unless components have been replaced or these adjustments have been disturbed. If, for any reason, recalibration becomes necessary, carefully perform the following procedures as required.

CALIBRATION OF THE 290 (SEE FIGURE 4 FOR ADJUSTMENT LOCATIONS): To gain access to the calibration adjustments it will be necessary to remove the back from this instrument. To remove the back cover, remove the two (2) screws located at the bottom rear and the two (2) screws at the rear near the top of the cover. After the screws have been removed, tilt the bottom part of the back cover outward (away from rear of unit) allowing the line cord to slide through opening and then gently lift the back cover up and away from the top portion of the front panel. Adjustments must be made in the order indicated below:

BIAS ADJUSTMENT: Connect an external voltmeter between + meter terminal and common ground (foil ground, common jack, etc.). Set the ZERO control so meter pointer rests over zero mark on VOLTS/MA scale. Adjust Bias adjustment (R53) so that external meter reads 6.5 volts.

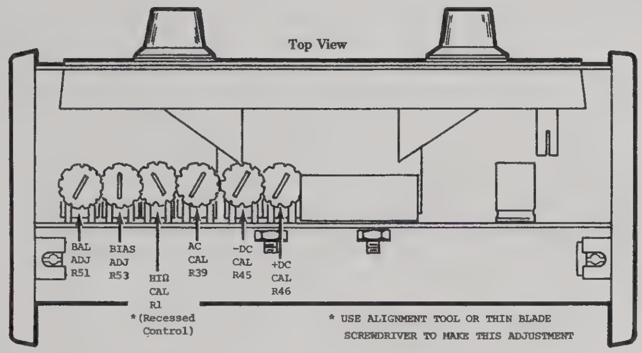


Figure 4. Adjustment Locations

BALANCE: The balance adjustment must be set to obtain the following results:

1. Slowest movement of meter pointer through zero (at left end of meter scale) when ZERO control is rotated.
2. An indication of .3 or higher on the 0 to .5 volt scale with ZERO control set fully clockwise.

To adjust the Balance adjustment, set the RANGE switch to the 1500 volt range, the FUNCTION switch to +DC V and the Balance adjustment to ½ rotation. Rotate ZERO control to ½ rotation and readjust Balance adjustment until meter reads zero. Rotate ZERO control fully clockwise. Meter pointer must indicate .3 or higher on 0 to .5 volt/mA scale. Readjust ZERO control for zero and closely observe movement of pointer through zero at left end of meter scale. If pointer movement appears to be too rapid, adjust Balance adjustment to obtain slowest movement of pointer through zero.

–DC VOLTS CALIBRATION: First check the setting of the mechanical and electrical zero adjustments. Set the RANGE switch to the 500mV range, and the FUNCTION switch to the –DC V position. Set the Probe switch to the 100K position. Apply exactly –0.5 volt DC to the input terminals and adjust –DC Cal Pot (R45) for exactly a .5 indication on the 0 to .5 VOLTS/MA scale.

+DC VOLTS CALIBRATION: Set FUNCTION switch to the +DC V position. Apply exactly 0.5 volts DC to the input terminals and adjust +DC Cal Pot (R46) for exactly .5 indication on the 0 to .5 VOLTS/MA scale.

AC VOLTS CALIBRATION: First check the setting of the mechanical and electrical zero adjustments. Set the RANGE switch to the 50mV position, and the FUNCTION switch to the AC V position. Set the Probe switch to the DIRECT position. Short the test leads together and zero meter. Apply exactly a 0.5 volt RMS sine wave (60Hz) to the input terminals and adjust AC Cal Pot (R39) for a .5 indication on the meter 0 to .5 VOLTS/MA scale.

NOTE

Calibration accuracy is dependent on accuracy of the calibrating source.

HI OHMS CALIBRATION: Set the FUNCTION switch to the LO OHMS position and the RANGE switch to the RX100 position. Set the Probe switch to DIRECT. Short test leads together and adjust ZERO control for exactly zero at left hand side of meter scale. Open test leads and adjust OHMS control to exactly infinity (∞) at right hand side of meter ohms scale. Set FUNCTION switch to HI OHMS and without touching Ohms control adjust HI OHMS Cal (R1) so that meter reads exactly infinity (∞).

REMOVING THE INSTRUMENT FROM ITS CASE: To gain access to the printed circuit board and for general servicing, the case (end pieces) must be removed from the front panel.

To remove the case, first remove the cover (see instructions under "Calibration and Maintenance"). Next, remove the two screws from the tie bar located at the top rear, just above the meter. Rotate the handle down toward the bottom rear of the instrument. Gently pull end pieces outward (sideways) and away from front panel. Lift end pieces up and away from front panel.

To remove the printed circuit board from the front panel, proceed as follows:

1. Remove the two (2) screws at the bottom rear of the unit that holds the transformer bracket in place.
2. Remove the two (2) large control knobs and control nuts on the front panel.
3. Slide the top portion of the meter back (away from front panel).
4. Remove the two (2) large meter retaining nuts located at approximately the center of the P.C. Board.
5. Remove the meter from the front of the P.C. board. Sufficient lead length is provided to allow servicing of the P.C. board components.

OVERLOAD PROTECTION: This instrument is protected against accidental overloads on all functions and all ranges. The voltage ranges are protected because the high input impedance limits the amount of voltage and current applied to the gate of the FET. On the resistance and current functions, the fuse F1 and diode D1 protect both the meter movement and the circuitry. This fuse should be replaced with one of the same type so that the protection feature and accuracy of this instrument are not affected. Accuracy of the RX0.1 range will be most affected by using an incorrect fuse type.

CIRCUIT DESCRIPTION

The Model 290 Electronic Multimeter uses a balanced bridge impedance converter consisting of a dual field effect transistor and a dual bi-polar transistor. This circuitry provides high input impedance and excellent stability.

When making DC voltage measurements the DC voltage is applied thru R11 to the voltage divider (R36 through R27). The RANGE switch S2B selects the required input voltage to be applied to the input gate of Q3A. The FET Q3A provides the necessary high input impedance, and drives the base of Q4A.

Q4 operates as a stable differential amplifier with the meter connected between the collectors. The base of Q4A is driven by Q3A for DC volts, ohms, and for DC current measurements. The base of Q4B (the 2nd half of the differential pair) is driven by Q3B for AC voltage and current measurements. This half of Q3B is in turn driven by the peak-to-peak detector, D8 and D9. In the DC volts, ohms and DC current functions, the peak-to-peak detector does not receive a signal from Q3A because of an AC rejection filter (R8, C4).

The dual FET and dual transistor are independent of temperature effects because they are small T0-71 and T0-78 packages and very little temperature differential can exist between sections.

In the resistance measurement function, a standard resistor is placed in series with either a 33mV or 1.25 volt source and the voltage is applied to the gate of Q3A. The meter will read up scale with this arrangement and the OHMS control allows adjustment at exactly full scale (∞). If the test leads are shorted together, the gate of Q3A will be shorted to ground and therefore receive no voltage. The meter then reads zero ohms. If a resistor between zero ohms and infinity resistance is placed between the test leads, the gate will receive a voltage proportional to the resistor ratios (internal standard and measured resistor) and the meter will indicate the resistance on the OHMS scale. If the resistance being measured is equal to the standard internal resistance of this instrument exactly one half of the voltage will be applied to the gate and the meter will read half scale. Voltages for both OHMS functions are obtained from a well regulated and filtered power supply.

The 33 millivolts for the LO OHMS function is developed across a voltage divider R67, R68, and R69, and applied directly to the gate of Q2A thru a standard resistor. With more IC's and transistors being used everyday the LO OHMS function of this instrument is a must for making resistance measurements in solid state circuits.

When making AC measurements the AC rejection filter is switched out and AC is applied to the same divider as is used for DC voltage measurements. However, capacitors across the divider now provide frequency compensation on all ranges. Therefore, all frequencies between approximately 30Hz and 250KHz are attenuated equally in this divider when switching ranges. The differential amplifier provides AC gain and the peak-to-peak detector develops a negative voltage dependent on the peak positive and the negative voltage swing of the input voltage fed to it. The gate of Q3B receives the detected signal, applies it to Q4B which in turn drives the

meter. Any DC voltage which would normally be applied to the gate of Q4B is shorted out in the AC volts functions by the switch.

When measuring current, a standard resistor is selected by the RANGE switch and put in series with the circuit to be measured. The voltage (AC or DC) developed across the standard resistor is then measured and read as current on the meter. The fuse F1 protects low value resistors which are more susceptible to burnout. Fuse protection is not required on high resistance value resistors. The meter movement itself is protected on all ranges because it is isolated thru the impedance converter.

WARRANTY SERVICE INSTRUCTIONS

1. Refer to the maintenance section of the instruction manual for adjustments that may be applicable.
2. Defective parts removed from units which are within the warranty period should be sent to the factory, prepaid, with model and serial number of product from which removed, and date of product purchase.
3. If the above mentioned procedures do not correct the difficulty, pack the product securely (preferably double packed). A detailed list of troubles encountered must be enclosed as well as your name and address. Forward prepaid (express preferred) to the nearest B & K authorized service agency.

Contact your local B & K Distributor for the name and location of your nearest service agency, or write to:

Service Department
B & K DIVISION OF DYNASCAN CORPORATION
2815 W. Irving Park Rd.
Chicago, Illinois 60613

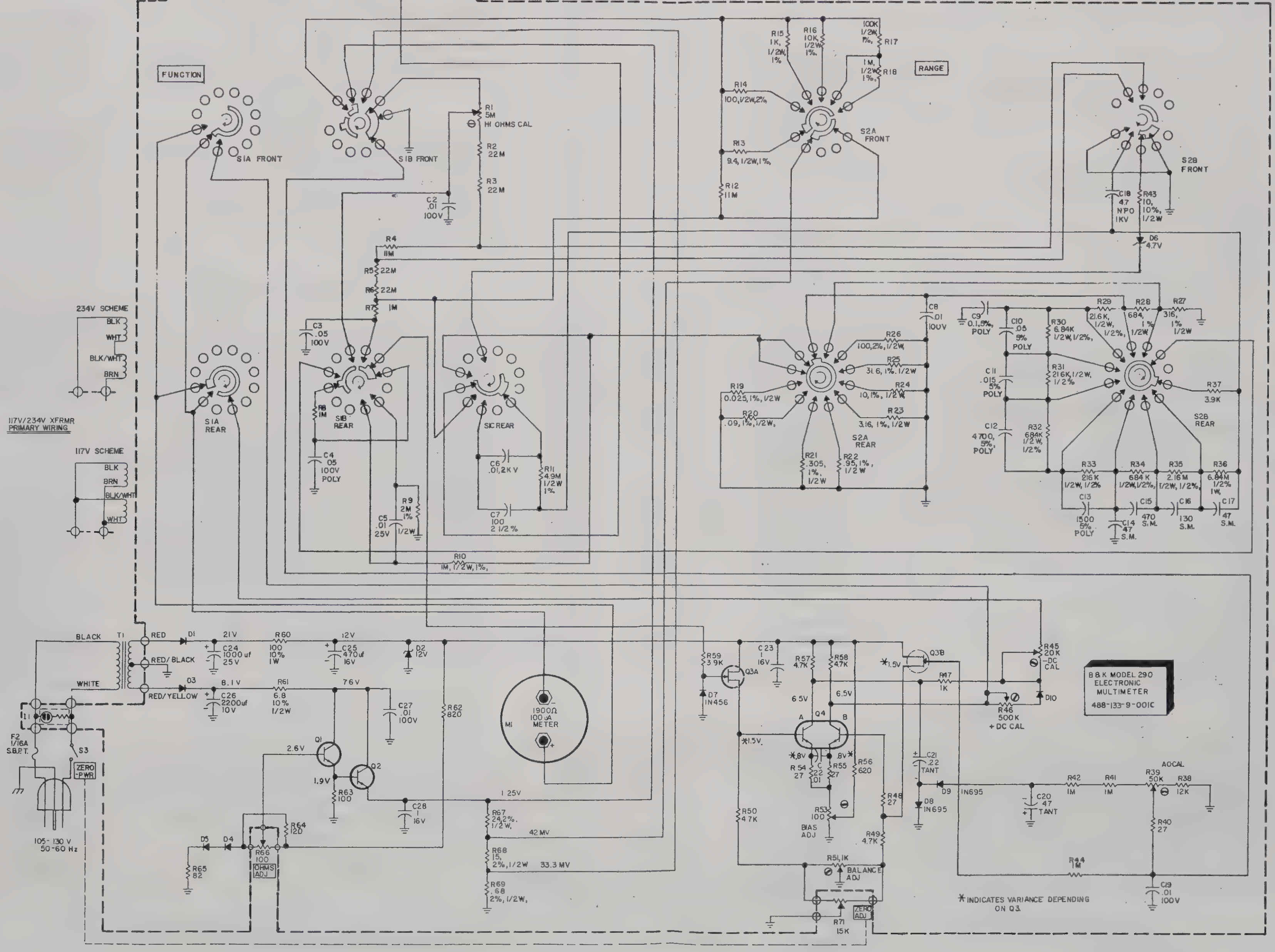
POSITION, RANGE SWITCH IN 1.5 KV POSITION AND NO SIGNAL INPUT
4. TITLES IN RECTANGLES INDICATE FRONT PANEL NOMENCLATURE.
5. SWITCHES ARE SHOWN IN FULL COUNTER CLOCKWISE POSITION, FUNCTION - DC V, RANGE 50 mV, AND ARE VIEWED FROM FRONT PANEL.
6. ABBREVIATIONS: K = 1000 M=1,000,000

TANT. - TANTALUM, 35V

FOIL GROUND CASE GROUND

5	LO OHMS	5V, 5mA, 14Vp-p, R x 1K
6	ACA	15V, 15mA, 42Vp-p, R x 10K
7	DCA	50V, 50mA, 140 Vp-p, R x 100K
8	——	150 V, 150mA, 420 Vp-p, R x 1M
9	——	500V, 500mA, 1400 Vp-p
10	——	1500 V, 1500mA, 4200 Vp-p

SCHEMATIC SUBJECT TO CHANGE WITHOUT NOTIFICATION.



B&K MODEL 290
ELECTRONIC
MULTIMETER
488-133-9-001C

LAST NUMBER USED	NOT USED
R71	R 52
C28	
D10	
Q4	
T1	
M1	
F2	
SG2	
S3	
I1	

CAPACITORS (Cont.)

SCHEMATIC SYMBOL	DESCRIPTION	B & K PART No.
C14, C17	47pfd, 500V, 5% P.F. Silver Mica Capacitor	023-044-9-001
C15	470pfd, 500V, 5% P.F. Silver Mica Capacitor	023-042-9-001
C16	130pfd, 500V, 5% P.F. Silver Mica Capacitor	023-041-9-001
C18	4.7pfd, ±.25pfd, 1KV, NPO P.F. Disc Capacitor	031-036-9-001
C20	.47μfd, 25V, 20% P.F. Tantalum Capacitor	027-006-9-001
C21	.22μfd, 25V, 20% P.F. Tantalum Capacitor	027-004-9-001
C24	1000μfd, 25V, Electrolytic Capacitor	022-107-9-001
C25	470μfd, 16V Electrolytic Capacitor	022-100-9-001
C26	2200μfd, Electrolytic Capacitor	022-108-9-001

DIODES & TRANSISTORS

SCHEMATIC SYMBOL	DESCRIPTION	B & K PART No.
D1, D3, D4, D5	Diode, Silicon, 1 Amp, 600 PIV	151-018-9-001
D2	Diode, Zener, 12V, 1W 5%	152-039-9-001
D6	Diode, Zener, 4.7V, 1W, 10%	152-052-9-001
D7	Diode, Silicon, 1N456	151-037-9-001
D8, D9	Diode, Germanium, 1N695	150-007-9-001
D10	Diode Silicon IN4148	151-038-9-001
Q1	Transistor Silicon Signal, NPN	176-023-9-001
Q2	Transistor, Silicon Low Power, NPN	176-008-9-001
Q3	FET, Dual N Channel	182-024-9-001
Q4	Transistor Signal, Dual NPN	176-041-9-001

SWITCHES

SCHEMATIC SYMBOL	DESCRIPTION	B & K PART No.
S1	Rotary Switch (Function)	083-140-9-001
S2	Rotary Switch (Range)	083-141-9-001
S3	Switch, ON-OFF	Part of R52

MISCELLANEOUS

SCHEMATIC SYMBOL	DESCRIPTION	B & K PART No.
F1	Fuse, 3AG, 1.25 Amp	191-004-9-001
F2	Fuse, Pigtail, 3AG, 1/16 Amp S.B.	193-004-9-001
T1	Transformer, Power, 117 Volts	065-074-9-003
	115 /230 Volts	065-074-9-002
	Direct/100K Probe	PR-21
	Instruction Manual	480-143-9-001
	Case, End Panel, Left	271-014-9-001
	Case, End Panel Right	271-015-9-001
	Handle	746-025-9-001
	Handle Stud	763-018-9-001
	Handle Friction Washer	731-013-9-001
	Handle Retaining "E" Ring	741-049-9-001
	Meter, 100μA, 1900Ω	320-046-9-001
	Meter Washer, Spring	731-028-9-001
	Knob, (Zero & Ohms)	751-064-9-001
	Knob, (Function & Range)	751-104-9-001
	Front Panel, for 320-046-9-001 meter	255-101-9-903
SG-1	Spark Gap, 2KV	033-014-9-001
SG-2	Spark Gap, 1.5KV	033-012-9-001

NOTE: Standard value resistors and capacitors are not listed, values may be obtained from schematic diagram.

Minimum charge $2.00 per invoice. Orders will be shipped C.O.D. unless previous open account arrangements have been made or remittance accompanies order. Advance remittance must cover postage or express charge.

B & K PRECISION MODEL 290 PARTS LIST

488-133-9-002 B

RESISTORS

SCHEMATIC SYMBOL	DESCRIPTION	B & K PART No.
R9	2M, ½W, 1% P.F Deposited Carbon Resistor	002-026-9-001
R10, R18	1M, ½W, 1% P.F. Metal Film Resistor	011-061-9-001
R11	4.9M, ½W, 1% P.F. Deposited Carbon Resistor	002-001-9-029
R13	9.4Ω, ½W, 1% P.F. Metal Film Resistor	011-063-9-001
R14, R26	100Ω, ½W, 2% P.F. Metal Film Resistor	011-067-9-001
R15	1K, ½W, 2% P.F. Metal Film Resistor	011-066-9-001
R16	10K, ½W, 2% P.F. Metal Film Resistor	011-020-9-001
R17	100K, ½W, 1% P.F. Metal Film Resistor	011-059-9-001
R19	.025Ω, ½W, 1%, 1.5A Shunt	004-135-9-001
R20	.09Ω, ½W, 1%, 500mA Shunt	004-117-9-001
R21	.305Ω, ½W, 1% P.F. Wirewound Resistor	004-112-9-001
R22	.95Ω, ½W, 1% P.F. Wirewound Resistor.	004-105-9-001
R23	3.16Ω, ½W, 1% P.F. Wirewound Resistor	004-136-9-001
R24	10Ω, ½W, 1% P.F. Metal Film Resistor	011-043-9-001
R25	31.6Ω, ½W, 1% P.F. Deposited Carbon Resistor	002-016-9-001
R27	316Ω, ½W, 1% P.F. Deposited Carbon Resistor	002-017-9-001
R28	684Ω, ½W, 1% P.F. Metal Film Resistor	011-058-9-001
R29	2.16K, ½W, ½% P.F. Metal Film Resistor	011-049-9-001
R30	6.84K, ½W, ½% P.F. Metal Film Resistor	011-050-9-001
R31	21.6K, ½W, ½% P.F. Metal Film Resistor	011-051-9-001
R32	68.4K, ½W, ½% P.F. Metal Film Resistor	011-052-9-001
R33	216K, ½W, ½% P.F. Metal Film Resistor	011-053-9-001
R34	684K, ½W, ½% P.F. Metal Film Resistor	011-054-9-001
R35	2.16M, ½W, ½% P.F. Deposited Carbon Resistor	002-020-9-001
R36	6.84M, 1W, ½% Deposited Carbon Resistor	002-019-9-001
R67	24Ω, ½W, 2% P.F. Metal Film Resistor	011-065-9-001
R68	.15Ω, ½W, 2% P.F. Wirewound Resistor	004-127-9-001
R69	.68Ω, ½W, 2% P.F. Wirewound Resistor	004-126-9-001

POTENTIOMETERS

SCHEMATIC SYMBOL	DESCRIPTION	B & K PART No.
R1	5 meg Trim Pot (HI Ω Cal)	008-161-9-001
R39	50K Trim Pot (AC Cal)	008-093-9-001
R45	20K Trim Pot (−DCV Cal)	008-139-9-001
R46	500K Trim Pot (+DCV Cal)	008-129-9-001
R51	1K Trim Pot (Balance Adj)	008-068-9-001
R53	100 Trim Pot (Bias Adj)	008-131-9-001
R66	100Ω Carbon Pot (Ohms Adj)	008-195-9-001
R71	15K Carbon Pot (Zero Control)	008-139-9-001

CAPACITORS

SCHEMATIC SYMBOL	DESCRIPTION	B & K PART No.
C1	.03μfd, 1000V, +80 −20 Ceramic Disc Capacitor	020-093-9-001
C6	.01μfd, 2000V, +80 −20 Ceramic Disc Capacitor	020-113-9-001
C7	100pfd, 500V, 2% P.F. Silver Mica Capacitor	030-034-9-001
C9	.1μfd, 200V, 5% P.F. Mylar Capacitor	025-075-9-001
C10	.05μfd, 200V, 5% P.F. Mylar Capacitor	025-064-9-001
C11	.015μfd, 250V, 5% P.F. Mylar Capacitor	025-037-9-001
C12	.0047μfd, 250V, 5% P.F. Mylar Capacitor	025-034-9-001
C13	.0015μfd, 600V, 5% P.F. Mylar Capacitor	025-035-9-001

Dear Friend:

Congratulations on your purchase of B & K-Precision Test Equipment, and welcome to the B & K-Precision family. We hope your experience with your new test equipment will make you a lifetime B & K-Precision customer.

Your instrument is backed by more than 20 years of xperience in designing and manufacturing. Our most important goal is your itisfaction. At B & K-Precision, test equipment is made to meet the demands of ie field, focusing on dependability and accuracy. We also concentrate on mplicity and operating ease with features that reduce the possibility of human rror and speed the servicing process.

In order to determine the type of test units that are needed we have been guided y letters and reports from technicians and engineers who use the equipment daily. ur field tests and studies have helped provide better and faster service techniques.

B & K-Precision product designs are constantly reviewed, and refinements are iade or new models developed to meet advances in our industry and to fill your eeds. We set our standards high so you can be assured that B & K-Precision test istruments you buy represent advanced design, quality construction, and ependable long-term performance at a price you can afford.

you have any comments or thoughts about our products, or test equipment in eneral, I would be delighted to hear from you.

Thanks for your confidence in B & K-Precision and we look forward to serving ou for a long time to come.

Sincerely,

Carl Korn

Carl Korn
President

INSTRUCTION MANUAL

FOR

Model 1248

DIGITAL IC COLOR GENERATOR

B+K PRECISION
DYNASCAN CORPORATION
6460 West Cortland Street
Chicago, Illinois 60635

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WARRANTY .... Cov. 3

INTRODUCTION

The Model 1248 Digital IC Color Generator incorporates the latest advances in igital circuit technology. The custom MOS integrated circuit contains all the ircuitry necessary for producing broadcast-quality video signals.

Nine patterns are programmed into the 1248 to provide for complete and easy ›nvergence of color receivers. Two crystal-controlled, keyed rainbow color isplays are provided to test color circuits, range of hue control and to align color ›modulators. A front panel COLOR LEVEL control permits displaying color ıturation to any degree up to 150% of sync amplitude.

Multiple dot and crosshatch patterns are provided for adjusting horizontal and ›rtical linearity, centering, and size on color or black and white TV receivers. Dot ze and vertical line width are sharp and bright. Preset to an optimum at the ıctory, they can be easily readjusted to suit personal preference.

Two crystal-controlled RF channels and a crystal-controlled IF output allow gnal injection at the tuner or into the IF section of a receiver.

A 4.5 MHz tuning aid is provided for easy set-up of the receiver fine tuning.

The 1248 also provides a video output signal for injection into a television ceiver beyond the video detector and for evaluation of video recorders. Positive-or ›gative-going sync of at least 1.5V P-P into 75 ohms is provided.

An oscilloscope trigger output is also provided for easy viewing of horizontal or ›rtical signals.

A zener-regulated power supply provides constant, ripple-free voltage to all ternal circuitry even under abnormal line conditions.

SPECIFICATIONS

PATTERNS

Purity	Clear raster
Dots	Single dot at center screen 7 x 11
Lines	Single vertical at center Single horizontal at center
Crosshatch	1 x 1, crosshair 7 x 11
Color Bars	R-Y, B-Y, –(R-Y): 3 bars gated at 90°, 180°, and 270° from burst. Gated Rainbow: 10 bars gated at 30° intervals from burst.

LINE WIDTH

Horizontal	1 horizontal scan line
Vertical	Preset to .25μSEC; internally adjustable from .1 to .8μSEC.

CHROMA

Offset subcarrier system utilizing a frequency of 3.579545 MHz minus 1 horizontal line (15734 Hz) or 3.563811 MHz ± .002%. 10 bars and R-Y, B-Y, –(R-Y) are produced by gating with 188.8 kHz and 63 kHz respectively. The chroma level is front panel adjustable from 0 to 150%.

SIGNAL SYNTHESIS

The 1248 uses a progressive scan system processed by a custom MOS integrated circuit which generates all sync and video information from a 377.6 kHz master crystal oscillator.

SYNC PULSES

	Horizontal	**Vertical**
Period	63.559μSEC (15734 Hz)	16.652mSEC (60.05 Hz)
Width	5.0847μSEC	190.677μSEC

BLANKING PULSES

	Front Porch	**Rear Porch**	**Total**
Horizontal	1.2712μSEC	5.0847μSEC	11.441μSEC
Vertical	223.73μSEC	983.9μSEC	1.398mSEC

F OUTPUT		
Channels	Crystal-controlled on CH. 3 (61.25 MHz) and CH. 4 (67.25 MHz). Selectable by front panel pushbuttons.	
Levels	10,000 microvolts minimum into a 300Ω Load.	
F OUTPUT		
Frequency	45.75 MHz, switch-selected, crystal-controlled	
Level	10,000 microvolts, minimum into 75Ω	
IDEO OUTPUT	0 to ±1.5V P-P, continuously variable into 75Ω	
YNC OUTPUT	5 V horizontal or vertical, switch-selectable	
UNING AID	4.5 MHz unmodulated carrier, ± .2% Fixed injection level of 30% of total modulation.	
OWER REQUIREMENTS	100 to 130 Volts AC, 60 Hz	
PERATING RANGE	From –25°C to 75°C	
ECHANICAL	Size	2.25" x 7" x 9.375"
	Weight	3 lbs.
	Cable Storage	24.75 cubic inches

OPERATING PROCEDURE

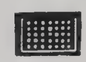
A. CONTROLS AND FUNCTIONS

1. COLOR LEVEL: Rotation of this control adjusts the color sub-carrier amplitude from 0 to 150%; at midpoint (indicator vertical) the level is normal or 100% of sync amplitude. In the extreme counterclockwise position, AC power to the unit is switched off.

2. PATTERN SELECTOR: Nine patterns are programmed into the 1248. In sequence:

Purity. Provides sync and reference black for a clear blemish-free raster.

Single Center Dot. Defines center screen and is useful for static convergence.

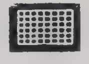


7 x 11 Dot Pattern. Used in static or dynamic convergence. Dot width is preset to .25 μSEC but may be readjusted internally to suit personal preference.

Single Vertical Line at Center Screen. Used for converging vertical lines.

Single Horizontal Line at Center Screen. Used for converging horizontal lines.

Crosshair. The intersection of the two lines corresponds to center screen and is useful for adjusting position as well as convergence.



7 x 11 Crosshatch. Extremely useful in dynamic convergence, linearity, size and overscan adjustments. The sharp definition of the horizontal and vertical lines helps to insure precise convergence.

R-Y, B-Y, –(R-Y). Derived from the rainbow pattern and gated at 90°, 180°, and 270°, respectively, to rapidly expedite color alignment procedures.

Gated Rainbow. 10 color bars raised on a 50% luminance pedestal and gated at 30° intervals from burst; they are used for testing and aligning color circuitry. The reference black background gives sharp edge definition and aids in recognizing color spill.

3. CARRIER SELECTION: The 1248 offers operation at three crystal-controlled carrier frequencies. Channel 3 (61.25 MHz), Channel 4 (67.25 MHz) or IF (45.75 MHz) can be selected by simply depressing the desired front panel pushbutton.

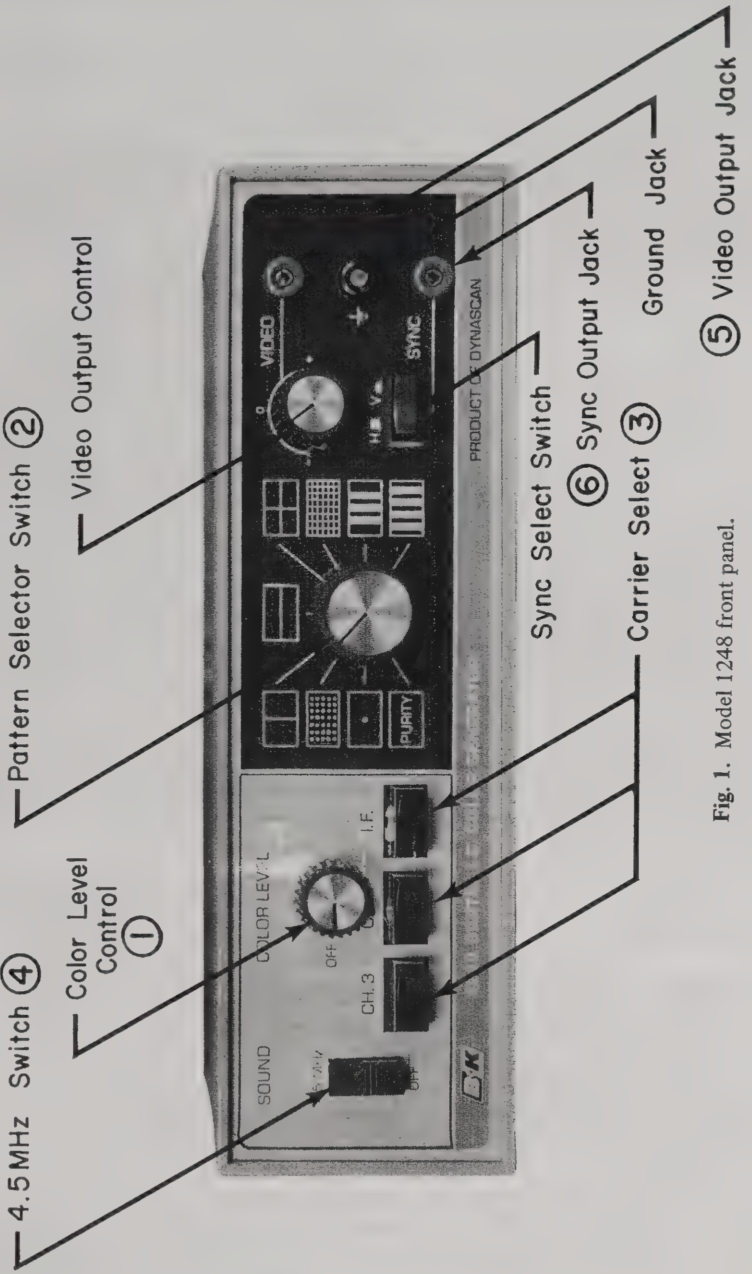
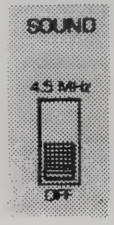


Fig. 1. Model 1248 front panel.

4. TUNING AID: The 4.5 MHz switch energizes an oscillator which inserts a 4.5 MHz subcarrier into the composite video and blanks the bars in the two color positions to provide an ungated rainbow. A 936 kHz "herringbone" pattern (4.5 MHz–3.56 MHz) will appear on the screen to aid in accurately fine-tuning the receiver.



5. VIDEO OUTPUT: The 1248 provides a video output for signal substitution directly into the video circuits of a television receiver and for testing video recorders. Clockwise rotation of the video output control will produce a composite video signal with positive-going sync. Counterclockwise rotation produces negative-going sync. A minimum of 1.5V of signal is produced into 75Ω.

6. SYNC OUTPUT: The 1248 also provides a sync output jack for use in synchronizing an oscilloscope for viewing the composite video waveform. When the pushbutton is "out", horizontal sync pulses are present at the output jack. Pushing the button "in" provides vertical sync pulses.

. OPERATION

NOTE

Read this entire section carefully to avoid unnecessary confusion and to obtain maximum performance from the 1248.

1. Disconnect all antenna lines from the receiver VHF antenna terminals; attach the 1248 RF cable to these terminals.
2. Tune both the receiver and generator to either channel 3 or 4.
3. Turn the instrument on by rotating the COLOR LEVEL control clockwise.
4. Rotate the pattern selector to GATED RAINBOW and set the COLOR LEVEL control to its midpoint position (indicator vertical); advance the receiver color level control approximately 1/4 from minimum. Adjust the contrast and brightness to provide a comfortable viewing intensity.
5. Slide the 4.5 MHz switch to the ON position. All bars will disappear.
6. Rotate the receiver fine tuning until an ungated rainbow with a light herringbone pattern appears; this is due to a beat between the sound and color subcarriers. Adjust the fine tuning once again for color with minimum herringbone. At this point, the receiver IF sound trap has attenuated the 4.5 MHz, and the receiver is properly tuned. Switch off the 4.5 MHz.

NOTE

With certain receivers, it may be impossible to either locate or tune out the herringbone. This may be due to a poorly aligned sound trap. An alternate method of fine tuning is presented if this occurs.

LTERNATE METHOD OF FINE TUNING:

1. Set the pattern selector to CROSSHATCH, switch off the 4.5 MHz and fine tune the receiver until a reasonably good display is obtained.
2. Reduce the contrast and brightness controls until both the horizontal and vertical lines are barely visible; one may be brighter than the other, but both should be *visible.*
3. Carefully readjust the fine tuning for brightest vertical lines, then reset the contrast and brightness for a comfortable viewing intensity.

NOTE

The 1248 possesses a high percentage of RF modulation. To obtain the sharpest test pattern and avoid "blooming" of the TV screen display, never operate the receiver with excessive contrast and brightness during convergence or color adjustments.

4. Rotate the pattern selector to GATED RAINBOW and set the COLOR LEVEL control to its midpoint position.
5. Advance the receiver color level control until color appears. When color does not appear at all or only with the control near maximum, carefully readjust the fine tuning. It should only require a slight amount of rotation; *excessive* rotation indicates tuner or IF misalignment. If this last step fails to produce color, it is likely that a malfunction exists somewhere in the receiver and must be corrected before proceeding. When the receiver is properly tuned, it is then ready for convergence and color adjustments.

C. VIDEO OUTPUT

Signal substitution can be carried out beyond the video detector using the video output signal provided by the 1248. Both positive and negative polarity signals are controlled by the VIDEO control. Clockwise rotation provides a signal with positive-going sync and CCW rotation provides negative-going sync. The peak-to-peak amplitude varies with control rotation.

Connect a test lead from the GND (black) jack on the 1248 to the receiver chassis. Connect another lead from the Video (red) jack on the 1248 to the receiver test location. (A pair of pin plugs are provided for test lead hook-up.) Set the VIDEO control to the proper polarity and amplitude.

Adjust the following receiver controls for a clear display: color, tint, brightness, and contrast.

A minimum of 1.5V P-P signal into 75Ω is available from the 1248. A 20μF DC blocking capacitor is built into the video output circuit of the 1248. The video output should not be connected to a location where more than ±200V is present.

D. OSCILLOSCOPE TRIGGERING

When it is desirable to view the video signals from the receiver on an oscilloscope the sync signals for triggering the scope are available from the 1248. This feature minimizes the readjustments required when viewing the video signal at the horizontal or vertical rate.

Connect a lead from the black GND jack on the 1248 to the receiver chassis. Connect another lead from the red SYNC jack on the 1248 to the oscilloscope EXT TRIGGER input. Set the trigger or sync control on the scope for external trigger and the polarity + (positive).

The trigger signal applied to the scope is determined by the SYNC selector switch. With the button "out", horizontal sync pulses are applied; when "in", vertical sync pulses are applied.

Once the oscilloscope controls are set, no further adjustments are necessary when viewing horizontal or vertical signals.

CONVERGENCE

A detailed convergence procedure will not be presented here, as there are many cellent and thorough manuals available on this subject; however, the principle attern uses are presented to help speed convergence.

. PURITY

The first position of the 1248 selector provides sync and a reference baseline ee of video information. This is advantageous when adjusting purity. Older ethods required turning to an unused channel or disabling the tuner; "snow" roduced by this method can be annoying and cause inaccuracy in set-up. Using is position, the operator can be assured that the adjusted purity condition will be aintained when the convergence procedure is initiated.

. STATIC CONVERGENCE

Static, or DC, convergence is always performed *before* and *after* purity djustments. The 1248 pattern switch is programmed to provide the necessary dot atterns in the positions following purity. The single center dot pattern is most onvenient because it automatically pinpoints screen center and is quickly located hen working from behind the receiver, viewing the screen at an angle.

. DYNAMIC CONVERGENCE

Crosshatch is the recommended pattern for performing dynamic convergence, lthough some technicians use dots throughout the entire procedure; this is a matter f personal performance. However, misconvergence is most easily seen with orizontal and vertical lines.

The single horizontal line and the single vertical line patterns are useful when onverging red and green lines at these locations. Elimination of all other lines emoves any confusion as to the correct points to converge.

NOTE

Defocusing, blooming and "kinks" at crosshatch intersections indicate that brightness and contrast are excessive. It is important never to perform convergence in this condition, or accuracy will greatly suffer.

COLOR ADJUSTMENTS

Service notes should always be consulted when testing and aligning color ircuitry. Following the recommended procedure will assure best performance. The ollowing sections provide a general technique if manufacturer's data is not vailable.

A. HUE SETTING AND RANGE

Step 1. Rotate the 1248 pattern selector to GATED RAINBOW and set the COLOR LEVEL control to its mid-point position.

Step 2. Adjust the receiver's saturation, brightness and contrast controls to produce a pleasing color pattern. Ten individual color bars should be visible on the face of the screen (see Fig. 2 and 4).

NOTE

Some receivers may only display eight or nine bars; this is due to excessive overscan and/or blanking.

Step 3. Turn the 1248 selector to R-Y, B-Y, –(R-Y). Three color bars, representing the third, sixth and ninth bar out of the gated rainbow should now be visible.

Step 4. Adjust the receiver's HUE control to display a red, blue, and bluish green bar in this order from left to right (see Fig. 3). If thi arrangement cannot be obtained with any setting of the HUE control then internal adjustment of hue range coil or control is necessary.

It can be assumed that the color circuits in the receiver are operating properl if these steps produce the correct results.

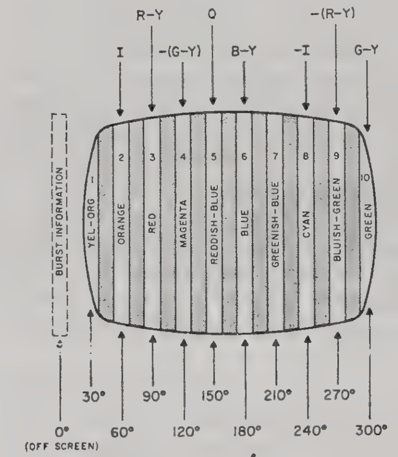


Fig. 2. Gated rainbow.

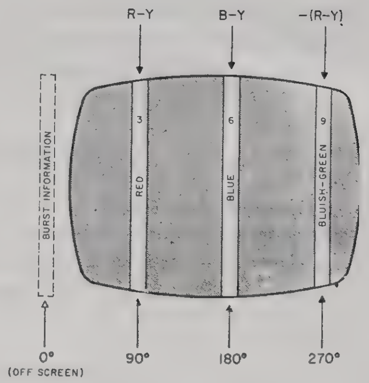


Fig. 3. R-Y, B-Y, –(R-Y).

B. DEMODULATOR ALIGNMENT CHECK

A rapid check of demodulator alignment can be performed without the use o a vectorscope right in the customer's home. This technique is simple and utilizes th color CRT itself as the analysis instrument.

Step 1. Rotate the 1248 selector to R-Y, B-Y, –(R-Y) and set the COLO LEVEL control to its mid-point position.

Step 2. Turn the receiver's contrast control to minimum and adjust th brightness for the brightest display possible without blooming; th receiver color control should be set to a very low level-just enough t produce color.

Step 3. Disable the red and green guns of the CRT. Adjust the HUE control so that color and shading in the area to the left and right of the first bar (left hand side of screen) matches the center section of that bar.

Step 4. Disable the blue and green guns and leave only the red gun active. If the color demodulators are properly aligned, the bar in the center of the screen will match the color and shading of the area to either side of it. A large amount of error usually indicates the need for demodulator alignment.

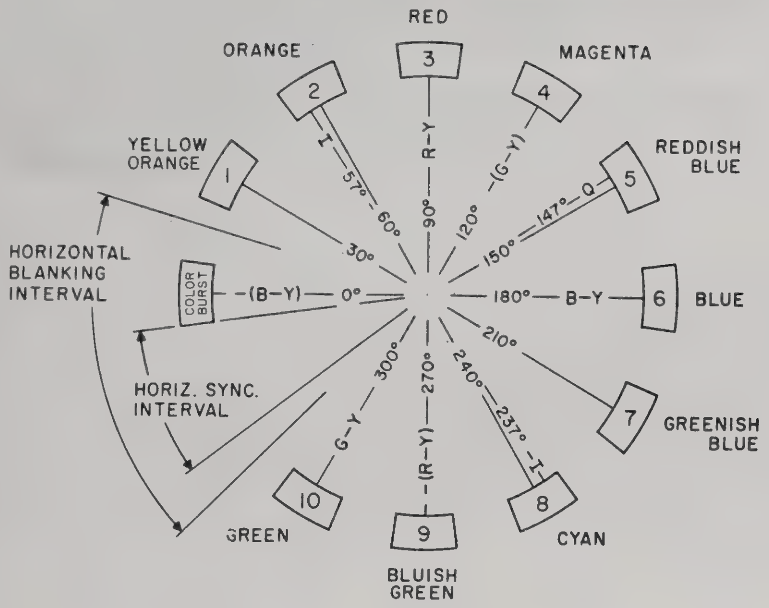


Fig. 4. Gated rainbow phase relation.

C. COLOR SYNC LOCKING

The COLOR LEVEL control on the 1248 varies the amplitude of the color subcarrier from 0 to 150%. Utilization of this control can help determine if the set will adequately lock on a color signal.

Step 1. Rotate the 1248 selector to GATED RAINBOW and adjust the COLOR LEVEL control to its mid-point position; this represents normal color subcarrier amplitude.

Step 2. Adjust the receiver color control to produce a recognizable color pattern.

Step 3. Slowly rotate the 1248 COLOR LEVEL control counterclockwise until the colors become pale and finally disappear; the rate of fading will depend entirely upon the model under test. Most receivers will maintain color sync throughout the entire range of the level control; however, some sets may lose it just before the color disappears, evidenced by their diagonal running. Both of these conditions indicate normal operation of the sync circuits. If a slight reduction of the chroma amplitude from normal causes the color to fall out of lock, synchronization of the receiver may be inadequate.

In the full clockwise position of the COLOR LEVEL control, the amplitude of the sub-carrier is 150% of sync amplitude. This additional range is helpful in diagnosing receiver conditions, such as RF/IF misalignment or chroma circuit malfunction.

D. COLOR FIT

The 1248 produces color bars that are raised on a luminance pedestal so that spaces between the colors are reference black. When displaying 10 and 3 bar patterns, color should only be seen in the luminance area; a defective delay line in the video amplifier or incorrect alignment of the chroma bandpass amplifier will cause the colors to overlap or spill into the black region.

E. COLOR KILLER

Color killer threshold can be set while displaying CROSSHATCH; adjust the color killer control of the receiver until the vertical lines start to tear with color. Back this control off until the tear is removed, then give a slight additional turn to provide a safety margin.

DEFLECTION SYSTEM TESTS

A rapid check of receiver scanning can help disclose any abnormal or border-line situations which might exist in the electrical or mechanical components of the deflection system. When evaluating any results from these tests, always use the manufacturer's recommendations as a criterion.

A. OVERSCAN

1. Rotate the 1248 pattern selector to CROSSHATCH.
2. Adjust receiver contrast and brightness to display sharp, thin lines against a black background.
3. Count the number of vertical and horizontal lines. A typical receiver will display 10 vertical and 7 horizontal lines. An additional vertical line, however, may just be visible at the screen's edge; this one is outside the normal picture area and should be ignored when performing adjustments.

NOTE

Certain receivers have an inherent tendency towards a greater amount of overscan and/or blanking. This phenomenon may result in a 9 x 7 crosshatch instead of a 10 x 7. The same effect will produce an 8 x 9 color bar pattern instead of 10.

B. LINEARITY, SIZE AND CENTERING

The repetitive spacing of the CROSSHATCH pattern provides a stable source with which to perform these tests and adjustments. Abnormal conditions such as pincushion distortion, deflection non-linearity and excessive 60 Hz hum become immediately obvious.

Vertical size and linearity should be adjusted so that all horizontal lines are evenly spaced. Inability to do so usually indicates a vertical deflection problem.

Pincushion distortion is common to a great number of large screen receivers; the outermost vertical and horizontal crosshatch lines are most useful in determining the correct amount of compensation.

A horizontal bar rolling vertically through the crosshatch pattern indicates that 60 Hz hum is entering the receiver circuitry. Excessive amounts of it cause a very noticeable and annoying pattern displacement.

The CROSSHAIR pattern provides 1 vertical and 1 horizontal line that intersect at exact screen center; any visual deviation from it may indicate a need for position adjustments.

THEORY OF OPERATION

The heart of the model 1248 Digital IC Color Bar Generator is the custom MOS digital integrated circuit. This 16-pin package contains all the digita countdown circuitry, gating logic, and D/A converters necessary to produce a composite video signal with a minimum of external components. See Fig. 5.

Pins 12 and 13 of the IC are the input pins to the on-chip oscillator circuit. A 377.6 kHz crystal is connected to these terminals to establish the master oscillato at this frequency. C3, C4, and R4 are added to stabilize the oscillator frequency Pins 3, 4, 5, and 6 are internally connected to a decoder ROM (Read Only Memory) which selects the proper video pattern (crosshatch, dots, etc.) from the BCD information provided to these pins by the PATTERN SELECTOR switch.

Vertical line width is determined by an RC timing network which is connecte to pins 7 and 8. Varying the resistance of R3 increases or decreases the width o vertical lines and dots. The vertical lines present at .25μSEC and may be adjuste from .1 to .8μSEC to suit personal preference.

The composite video output appears at pin 9 and the color bar gating signa appears at pin 10. Sync signals appear at pin 1 with horizontal or vertical bein selected by a high or low at pin 16.

Transistor Q2 adds the color bar gating signal to the sync signal and als provides a luminous step for the color bars. Q2 also provides positive and negativ video signals which are buffered by Q3 and are available at the video output on th front panel.

Transistor Q4 is a modified Crystal-Colpitts oscillator with R22 (COLOR LEVEL) as the load resistor; the output is thus variable in amplitude from 0 t 150% of sync level. Q5 is operated as a switch which grounds the color signa between bars. The gating signal comes from pin 10 of IC1 and is buffered by Q which drives the base of Q5.

Transistor Q6 and surrounding components comprise a temperature-compensated 4.5 MHz oscillator which generates the sound subcarrier used as a tunin aid. Capacitor C22 injects a level of 30% total modulation excursion into th modulator. A front panel slide switch controls power to this circuit and also blank the bar patterns to provide an ungated rainbow.

The assembled composite video from Q2 is sent to the VHF OSCILLATOR MODULATOR where it is impressed upon the desired RF frequency and route through the output cable. Q7 and surrounding components form a crystal-controlled VHF oscillator that generates the carrier frequency. Front panel push buttons control the DC bias to six RF switching diodes thereby energizing th desired crystal and selecting the proper resonating capacitor for the tank circuit Modulator transistor Q8 is a low-capacity device connected as a diode; this schem provides temperature compensation and a high modulation percentage. Shielde coaxial cable is provided for convenient connection to the receiver terminals.

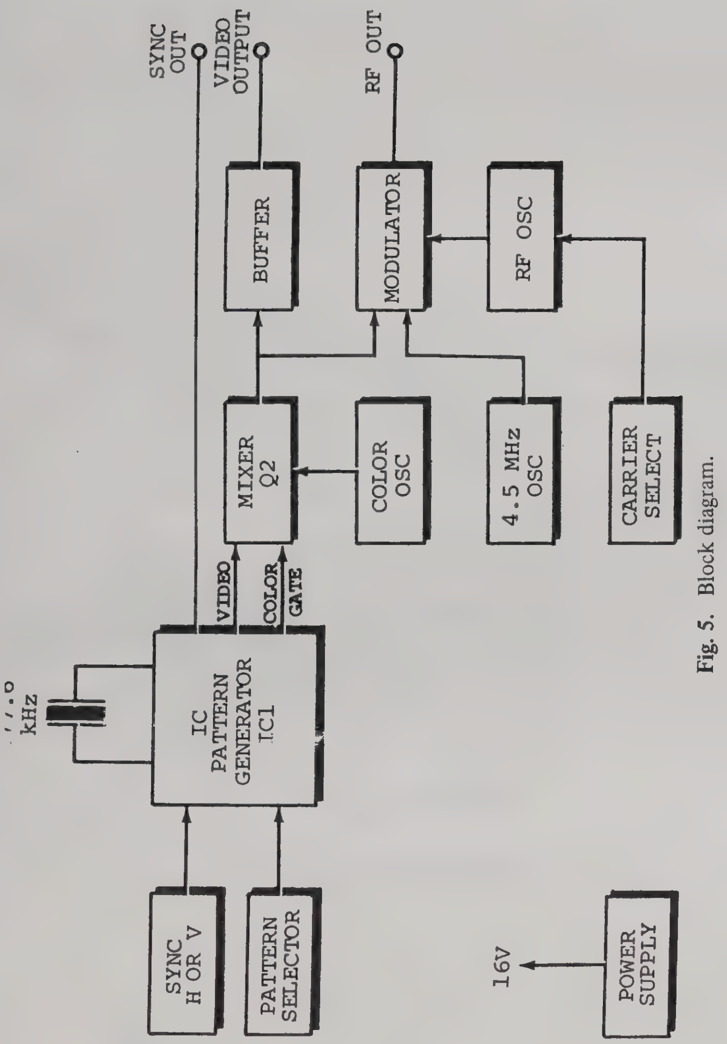


Fig. 5. Block diagram.

CALIBRATION AND MAINTENANCE

The 1248 is aligned and calibrated at the factory for optimum performance. As a result, access to the instrument's interior is only necessary for dot size readjustment–all other trimming controls should not be touched. If misalignment occurs either through damage or accidental movement, recalibration is possible by following the procedures in succeeding sections.

A. DOT SIZE

Trimmer control R3 DOT SIZE (See Fig. 6) varies the width of pulses used to construct dots and vertical lines. It is preset to .25μSEC, which has been found to produce a sharp, bright dot on the majority of receivers. If readjustment is preferred, simply display a dot pattern and rotate this control until the desired size is obtained. Since vertical lines are also affected, it is wise to inspect the crosshatch pattern; a compromise between optimum dot size and vertical line width may be necessary.

B. RF OSCILLATOR/MODULATOR

Because the RF carrier of the 1248 is crystal-controlled, it is not necessary to retune L2 when changing channels; it has purposely been damped so that Q7 will oscillate with either of the crystals. If operation on one channel should cease, rotate L2's slug to see if it can be restored before suspecting component failure.

It is necessary to view the detector output of a working receiver with an oscilloscope when calibrating the MOD trimmer, R15.

1. Set-up the receiver and generator to display CROSSHATCH.
2. Adjust the oscilloscope to view two vertical fields of the recovered waveform.
3. Rotate R15 until the sync amplitude (upper half) of the composite signal equals the video amplitude (lower half).

C. COLOR OSCILLATOR

A frequency counter, with input impedance of greater than 100kΩ. is needed to perform the following adjustments:

1. Rotate the 1248 selector to GATED RAINBOW and turn the unit on.
2. Attach the frequency counter across the COLOR LEVEL control and rotate the COLOR LEVEL control fully clockwise.
3. Adjust "COLOR TRIM" capacitor (C11) with a non-metallic tool until a reading of 3.563811 MHz in obtained.

D. 4.5 MHz OSCILLATOR

1. Attach the frequency counter to the emitter of Q6 (see Fig. 6).
2. Slide the actuator of the 4.5 MHz front panel switch to ON and adjust L1, 4.5 ADJ, for a reading of 4.500 MHz. Calibration is now complete.

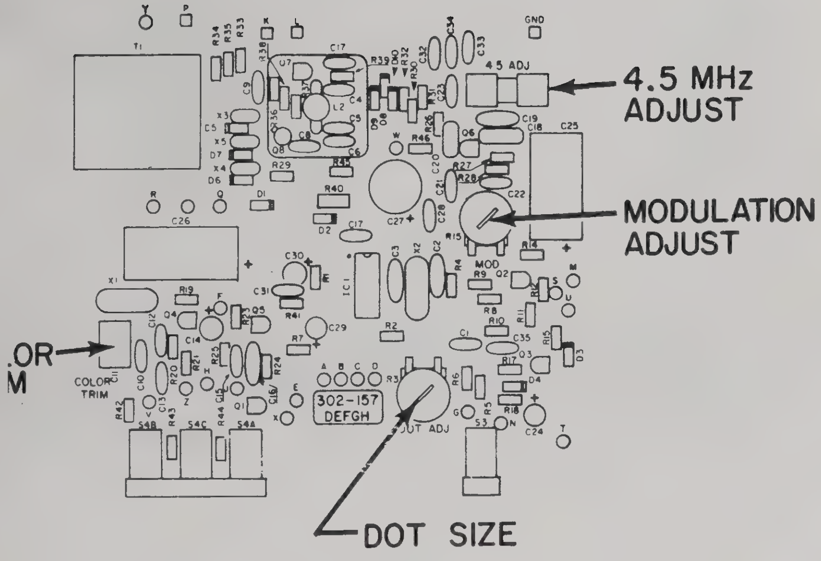


Fig. 6. Location of internal adjustments.

WARRANTY SERVICE INSTRUCTIONS

1. Refer to the MAINTENANCE section of your B & K-Precision instruction manual for adjustments that may be applicable.
2. Defective parts removed from units which are within the One Year Limited Warranty period should be sent PREPAID to the Service Department listed below. Be sure to state the model and serial number of the unit from which the parts were removed and date the unit was purchased. These parts will be exchanged at no charge, under the terms of the Warranty.
3. If the above-mentioned procedures do not correct the problem you are experiencing with your unit, pack it securely (preferably in the original carton or double-packed). Enclose a letter describing the problem and include your name and address. Deliver to, or ship PREPAID (UPS preferred) to the nearest B & K-Precision authorized service agency (see list enclosed with unit).

If your list of authorized B & K-Precision service agencies has been misplaced contact your local distributor for the name of your nearest service agency, or write to:

Service Department

B & K-Precision Product Group
DYNASCAN CORPORATION
2815 West Irving Park Road
Chicago, Illinois 60618

LIMITED ONE-YEAR WARRANTY

DYNASCAN CORPORATION warrants to the original purchaser that its B & K-PRECISION product, and the component parts thereof, will be free from defects in workmanship and materials for a period of one year from the date of purchase.

DYNASCAN will, without charge, repair or replace, at its option, defective product or component parts upon delivery to an authorized B & K-PRECISION service contractor or the factory service department, accompanied by proof of the date of purchase in the form of a sales receipt.

To obtain warranty coverage, this product must be registered by completing and mailing the enclosed warranty registration card to DYNASCAN, B & K-PRECISION, P.O. Box 35080, Chicago, Illinois 60635 within five (5 days) from the date of purchase.

Exclusions: This warranty does not apply in the event of misuse or abuse of the product or as a result of unauthorized alterations or repairs. It is void if the serial number is altered, defaced or removed.

DYNASCAN shall not be liable for any consequential damages, including without limitation damages resulting from loss of use. Some states do not allow limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

This warranty gives you specific rights and you may also have other rights which vary from state to state.

For your convenience we suggest you contact your B & K-PRECISION distributor, who may be authorized to make repairs or can refer you to the nearest service contractor. If warranty service cannot be obtained locally, please send the unit to B & K-PRECISION Service, 2815 West Irving Park Road, Chicago, Illinois 60618

CHEMATIC YMBOL	DESCRIPTION	B & K PART NO.

SWITCHES

1	9-Position Rotary, Function	083-167-9-001
2	DPDT Slide, "4.5MHz"	084-017-9-001
3	Pushbutton, "SYNC"	088-024-9-001
4	3-Station, Pushbutton	088-025-9-001

MISCELLANEOUS

	Cable, RF	539-029-0-000
	Case, Leather, Carrying	271-026-9-001
	Foot, Rubber	381-004-9-001
	Instruction Manual	480-158-9-001
	Jack, Tip, Black	773-055-9-001
	Jack, Tip, Red	773-056-9-001
	Knob, Control	751-069-9-001
	Knob, Rotary Switch	751-114-9-001
	Knob, Pushbutton	384-018-9-001

NOTE: Standard value resistors and capacitators are not listed. Values may be obtained from chematic diagram. Minimum charge $5.00 per invoice. Orders will be shipped C.O.D. unless revious open account arrangements have been made or remittance accompanies order. Advance remittance must cover postage or express charges. Specify serial number when ordering replacement parts.

CORPORATION • 6460 W. Cortland St. • Chicago, IL 60635

B&K-PRECISION MODEL 1248 PARTS LIST

488-142-9-002 C

SCHEMATIC SYMBOL	DESCRIPTION	B & K PART NO.

RESISTORS & POTENTIOMETERS

R3	100k, ±30%, 1/8W, Trimpot	008-216-9-00
R13	10k, ±30%, 1/4W, Carbon Pot, VIDEO	008-215-9-00
R15	2k, ±30%, 1/8W, Trimpot	008-217-9-00
R22/S5	1k, ±30%, 1/4W, Carbon Pot/Switch, COLOR LEVEL	008-214-9-00

CAPACITORS

C11	2-20pf, Trimmer	028-001-9-00
C14, C30	10 MF, 25V Tantalum	027-006-9-00
C18	.0015 MF, ±5%, Mylar	025-035-9-00
C19	90 PF, N750, ±5%, Ceramic Disc	020-079-9-00
C20	390 PF, ±5%, Silver Mica	023-004-9-00
C21	180 PF, ±5%, Silver Mica	023-025-9-00
C24, C29	22 MF, 16V, Electrolytic	022-085-9-00
C25	20 MF, 250V, Electrolytic	021-034-9-00
C26	1000 MF, 25V, Electrolytic	022-107-9-00
C27	470 MF, 25V, Electrolytic	022-095-9-00

COILS & TRANSFORMERS

L1	4.5 MHz Coil	044-023-9-00
L2	RF Oscillator Coil	044-017-9-00
T1	Power Transformer	065-063-9-00

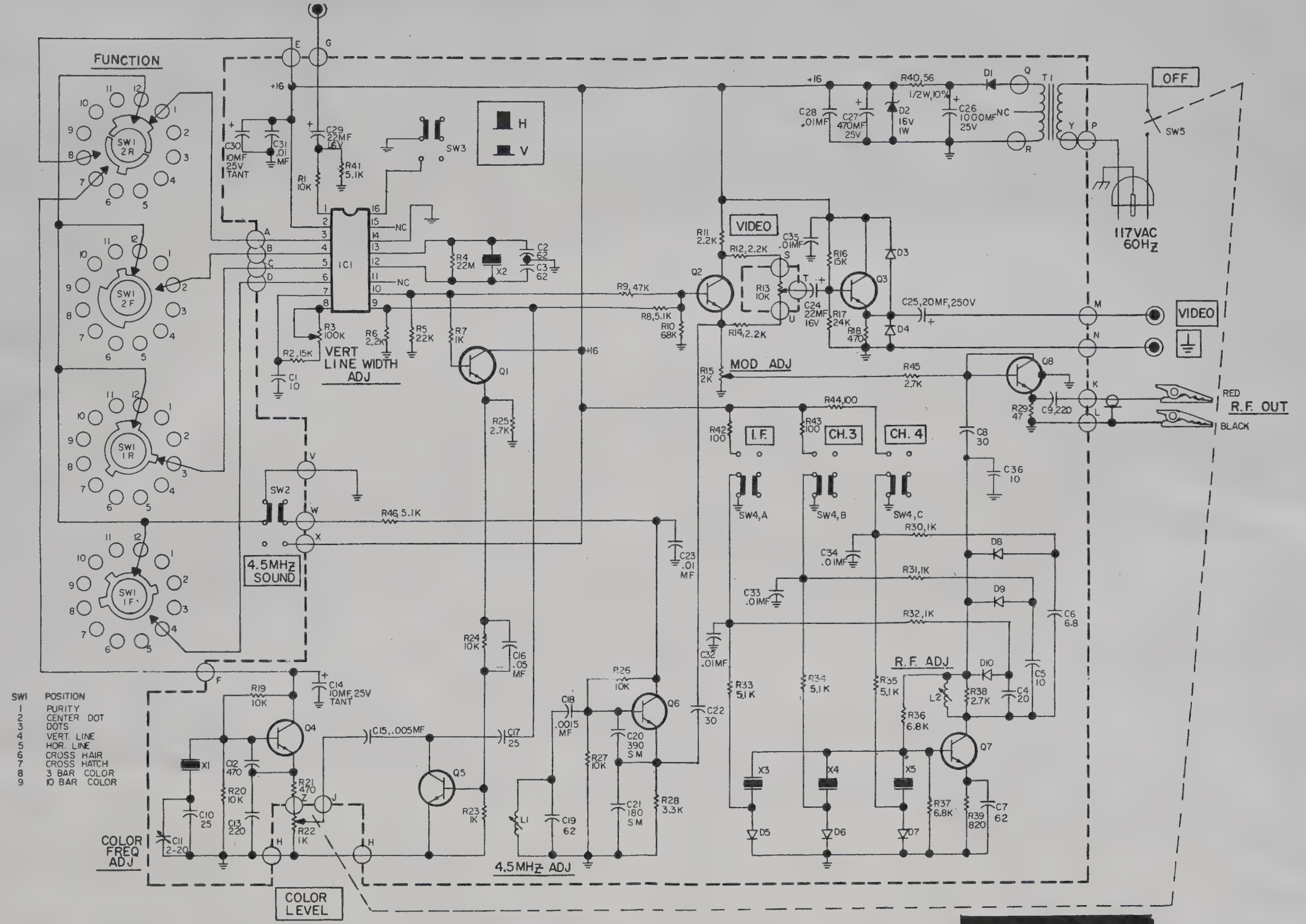
CRYSTALS

X1	3.563795 MHz	131-003-9-00
X2	377.6 kHz	131-018-9-00
X3	45.75 MHz	132-002-9-00
X4	61.25 MHz	132-004-9-00
X5	67.25 MHz	132-004-9-00

DIODES, TRANSISTORS & IC'S

D1,D3,D4	1A Silicon Diode	151-050-9-0
D2	16V, ±5%, 1W, Zener Diode	152-009-9-0
D5-D10	1N4148 Silicon Diode	151-038-9-0
Q1-Q6	MPS A20, NPN, Silicon Transistor	176-023-9-0
Q7	SE1010, NPN, Silicon Transistor	176-005-9-0
Q8	40897, NPN, Silicon Transistor	176-040-9-0
IC1	MM5322, Custom MOS Integrated Circuit	307-057-9-0

COMPOSITE



SW1	POSITION
1	PURITY
2	CENTER DOT
3	DOTS
4	VERT. LINE
5	HOR. LINE
6	CROSS HAIR
7	CROSS HATCH
8	3 BAR COLOR
9	10 BAR COLOR

LAST NO.'S USED
R46
C36
D10
Q8

UNLESS OTHERWISE SPECIFIED:
1. ALL RESISTANCE IN OHMS 1/4W, 5%
2. ALL CAPACITORS IN P.F.
3. SW1 SHOWN IN FULL CCW POSITION (PURITY)
SW2,SW4,SW5 SHOWN IN OFF POSITION (SW3 SHOWN IN HOR. POSITION, OUT)
4. TITLES IN RECTANGLES INDICATE FRONT PANEL NOMENCLATURE
5. ABBREVIATIONS:
K=1,000 TANT= TANTALUM ⏚ = CASE GROUND

B&K
MODEL 1248
DIGITAL I.C. COLOR
GENERATOR

INSTRUCTION MANUAL

B+K PRECISION 520B

TRANSISTOR TESTER

B+K PRECISION DYNASCAN CORPORATION

TEST INSTRUMENT SAFETY

WARNING

An electrical shock causing 10 milliamps of current to pass through the heart will stop most human heartbeats. Higher voltages pose an even greater threat because such voltages can more easily produce a lethal current. However, voltage as low as 35 volts DC or AC RMS should be considered dangerous and hazardous since it can produce a lethal current under certain conditions. Your normal work habits should include all accepted practices that will prevent contact with exposed high voltage, and that will steer current away from your heart in case of accidental contact with a high voltage. Be alert to the following hazards when using the Model 520B Transistor Tester:

1. When performing in-circuit testing of semiconductors, make sure power is removed from the circuit under test. For “hot chassis” equipment, disconnect the power plug in addition to turning off the on-off switch. Most recent television sets, audio equipment, and other equipment with a 2-wire power cord are transformerless “hot chassis’ powered, where one side of the ac power line connects directly to the chassis. If such equipment does not have a polarized power plug to prevent insertion the "“wrong” way, a serious shock hazard exists if the chassis is touched. Additionally, damage to the semiconductor tester or the equipment under test could result. Unplug any such equipment from its ac outlet; just turning off the on-off switch does not eliminate the hazard. To be on the safe side, treat all equipment as “hot chassis” unless you are sure it has an isolated chassis or an earth ground chassis.

2. Servicing of the transistor tester should be performed only by qualified electronics technicians who are trained to work safely in the presence of high voltage. Line voltage (120 or 240 VAC) may be present at points in the primary power circuit any time it is connected to an ac outlet, even if the unit is turned off. Always observe caution when the covers are removed from the tester.

INSTRUCTION MANUAL

for

Model 520B

TRANSISTOR TESTER

B+K PRECISION

DYNASCAN CORPORATION
6460 W. Cortland Street
Chicago, Illinois 60635

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INTRODUCTION

The B & K-Precision Model 520B Transistor Tester is designed for in-circuit and out-of-circuit transistor testing, with special features for making additional tests on devices out-of-circuit.

It uses both a high-current, low duty-cycle pulse technique to test transistors in the presence of shunting circuitry, and a low-current drive system which enables the user to identify the terminals of the device in most in-circuit tests and all out-of-circuit checks.

The instrument is designed for a minimum amount of control manipulation, making for rapid testing of most devices.

SPECIAL FEATURES

1. Patented limited-energy pulse circuit permits highly successful use of in-circuit testing in the presence of low shunt impedances with complete safety for the device under test.
2. A human-engineered panel design which eliminates the need for reference to the operating manual – only three switches, no panel adjustments.
3. Six-position TEST switch sequentially connects the device being tested in all possible configurations, making it unnecessary to know the device terminal identification. Can be left in GOOD position so that additional tests can be made without memorizing test position.
4. Base or gate lead identified by color as TEST switch is operated when testing with HI drive. All leads of transistor are identified when testing with LO drive.
5. Audible tone tells when the device under test is good – no need to take eyes off circuit board while testing hard-to-get-at devices.
6. A logarithmic leakage meter which displays a wide leakage current range on a single meter scale.
7. Automatic polarity indication to identify NPN or PNP type devices.
8. Identification of SILICON and GERMANIUM device types for proper evaluation of leakage current with color-keyed LED indicators for positive test interpretation.
9. Clip-on test leads that make positive connections to devices in difficult locations. Free operator's hands to make further tests.
10. Choice of test leads or front panel socket for out-of-circuit tests.

SPECIFICATIONS

IN-CIRCUIT:

GOOD/BAD test for transistors, FET's, or SCR's.
Identifies transistor as NPN or PNP and FET as N or P channel.
Identifies SILICON or GERMANIUM transistors.
Identifies gate lead of FET or base lead of transistor (HI drive).
Identifies all leads of transistor when using LO drive.
Identifies all leads of SCR's.

OUT-OF-CIRCUIT:

GOOD/BAD test for transistors, FET's or SCR's.
Identifies transistor as NPN or PNP and FET as N or P channel.
Identifies SILICON or GERMANIUM transistors.
Identifies gate lead of FET by test lead color.
Identifies all leads of transistor or SCR by test lead color.
Measures reverse LEAKAGE from 0.1 μA to 5 mA.
Measures I_{DSS} and gate leakage of FET's.

APPLIED TEST CURRENTS:

Base Drive: 250 mA (HI drive) or 1 mA (LO drive) at 4% duty cycle.
Collector Drive: 125 mA at 4% duty cycle.
Test Repetition Rate: 10 per second.
Reverse Voltage for leakage test: 2.0V.

LIMITING IN-CIRCUIT SHUNT VALUES FOR VALID GOOD/BAD TEST:

Resistance: Down to 10 ohms with HI drive.
Down to 1.5K ohms with LO drive

Capacitance: Up to 15 mfd with HI drive.
Up to .3 mfd with LO drive.

ACCESSORIES:

Three test leads with mini-lock clips supplied.
FP-5 Dynaflex Probe (optional).

SIZE: 8" x 7" x 3½"

WEIGHT: 5 lbs.

POWER REQUIREMENTS: 120 VAC, 60 Hz, 5 watts.

BRIEF SUMMARY OF WHAT THE 520B WILL DO

1. Determines good or bad transistors, FET's or SCR's, in or out-of-circuit.
2. Determines good or bad diodes in or out-of-circuit.
3. Identifies Emitter-Base-Collector leads of transistors.
4. Identifies gate lead of FET's.
5. Indicates polarity of good devices (NPN or PNP; N or P Channel).
6. Identifies Cathode-Gate-Anode leads of SCR's.
7. Indicates whether SILICON or GERMANIUM.
8. Measures I_{CES} or I_{BES} of transistors.
9. Measures I_{DSS} and gate leakage of FET's.
10. Measures reverse leakage current of diodes.
11. Determines whether device is transistor, FET or SCR.

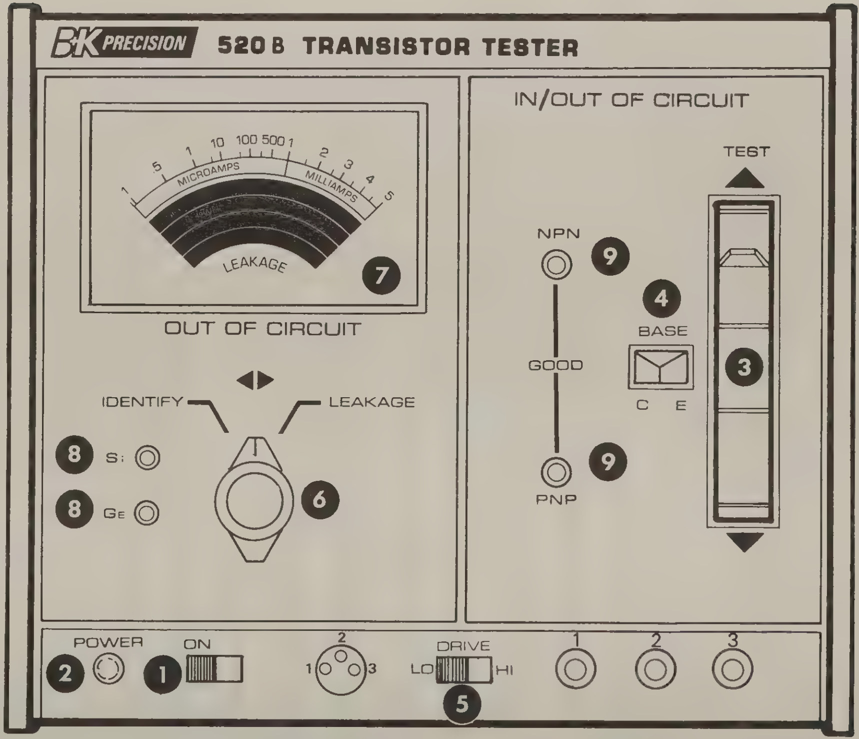

Fig. 1. Front panel showing controls and indicators.

CONTROLS AND INDICATORS

1 **POWER ON Switch:**	Applies power to 520B
2. **POWER ON Lamp:**	Indicates power is ON.
3. **TEST Switch:**	Selects proper device connection for testing and lead identification.
4. **Lead Identification Window:**	Identifies leads by color.
5. **DRIVE Switch:**	Selects LO or HI base drive.
6. **FUNCTION Switch:**	Spring-return switch selects either of two additional tests: a. I_{CES} or I_{BES} for transistors; I_{DDS} and gate leakage for FET's. b. Identifies device material (silicon or germanium).
7. **LEAKAGE Meter:**	Indicates device leakage current. a. Indicates safe leakage limits for typical silicon and germanium transistors. b. Indicates I_{DSS} and gate leakage for FET's.
8. **IDENTIFY Lamps:**	Indicate silicon or germanium device.
9. **NPN and PNP Lamps:**	Indicate polarity of good devices.
10. **AUDIBLE TONE:**	Indicates good device.

HINTS AND KINKS

IDENTIFYING TRANSISTORS AND DIODES

1. Nearly all germanium transistors come in metal cases, either the tubular type with flexible leads, or in the standard TO-5 package.

2. Power transistors in stud packages or in the TO-5 or TO-3 can be either germanium or silicon, depending on age. Two and three digit 2N-numbers are mostly germanium.

3. The TO-66 power transistors and the plastic power tab packages are nearly always silicon. The collector is usually, but not always, connected to the mounting tab and the center lead.

4. The base lead of most modern plastic type transistors is either the center lead or the right hand lead when facing the flat side with the leads down. In the latter case the collector lead is in the middle.

5. Most plastic FET's have the gate lead on the right side when facing the flat side with the leads down, and the source in the middle, but there are exceptions. With nearly all junction FET's, the source and drain can be interchanged with no adverse effects.

6. All transistors will have some gain with the collector and emitter leads interchanged, with the exception of Darlingtons.

7. Germanium signal diodes can usually be recognized by their transparent hollow glass cases with either three or four color bands, or type numbers printed on them. Silicon diodes are usually painted because silicon is light-sensitive and must be protected from ambient light. The "moose" types, such as the stud package, can be either germanium or silicon.

THINGS TO KNOW ABOUT THE 520B

1. There are certain semiconductor devices that look like transistors which the 520B cannot test. These include: Triacs, diacs and diode arrays.

2. In HI drive, most transistors that test good will do so in *two* adjacent TEST switch positions. This is because transistors have some gain when the collector and emitter are interchanged. If the circuit is heavily shunted, or the "reverse beta" of the transistor is very low, the transistor will test good in only *one* TEST switch position. In either case, the transistor can be considered good.

3. In LO drive, most transistors that test good will do so in only *one* TEST switch position. In some rare cases, high-frequency transistors or transistors with higher than usual "reverse beta" may test good in *two* adjacent TEST switch positions having the same BASE color in the Lead Identification Window. This is still a valid good test, but only the base lead of the transistor can be identified.

4. FET's can be tested in either LO or HI drive, but only FET's with a high G_m will test good in LO drive. Therefore, to insure a valid good/bad test for all junction FET's, the DRIVE switch should be set to HI when the device being tested is known to be an FET. The 520B detection circuit is more sensitive in the HI drive position.

USING THE MODEL 520B

IN-CIRCUIT TESTING

CAUTION: Make sure all power is turned off in the circuit being tested, and that all capacitors are discharged.

A. Transistors/FET's

1. Set the DRIVE switch to the LO position.

2. Connect the three test leads in any manner to the three leads of the device you wish to test.

3. Move the TEST switch slowly through its six positions or until the tone is heard. One of the two red lamps will glow indicating whether the device is NPN or PNP, or N or P channel (the NPN lamp will glow if the FET is N Channel and the PNP lamp will glow if the FET is P Channel). In LO drive, most transistors that test good will do so in only *one* TEST switch position (see THINGS TO KNOW ABOUT THE 520B). In this TEST switch position, all the leads of the transistor can be identified as shown in the Lead Identification Window. Most FET's will test good (LO or HI drive) in *two* adjacent TEST switch positions having the same BASE color shown in the Lead Identification Window, since practically all junction FET's are symmetrical. The BASE color indicated is the *gate* lead of the FET.

4. If no tone is heard as the TEST switch is slowly moved through its six positions, in LO drive, then the device under test is one of the following:

    a. Transistor with high leakage or very low gain (may not function properly in circuit).

    b. Device with open/shorted elements.

    c. Device with excessive circuit shunting (see SPECIFICATIONS).

    d. FET that will not test with LO drive.

5. Retest the device using HI drive. In HI drive, most transistors that test good will do so in *two* adjacent TEST switch positions having the same BASE color shown in the Lead Identification Window. Only the base lead of the transistor can be identified.

6. If the device tests good using HI drive, then 4 (a) above could be true.

7. If the device does not test good in any TEST switch position, in HI drive, remove the device from the circuit and retest using OUT-OF-CIRCUIT procedures.

B. SCR's

1. Set the DRIVE switch to the HI position.

2. Connect the three test leads in any manner to the three leads of the SCR you wish to test.

3. Move the TEST switch slowly through its six positions or until the NPN lamp glows in one position and the PNP lamp glows in another position having a different BASE color as shown in the Lead Identification Window.

4. The SCR is good *only* if all the following are obtained:

   a. One NPN indication.

   b. One PNP indication.

   c. Indications must not have same BASE color.

   LEAD IDENTIFICATION:

   a. The BASE color shown in the Lead Identification Window is the *gate* lead when the NPN lamp glows.

   b. The BASE color shown in the Lead Identification Window is the *cathode* lead when the PNP lamp glows.

5. If the SCR tests bad, then it should be removed from the circuit and tested again (may be subject to excessive shunting in-circuit).

C. Diodes

Connect the blue and yellow test leads across the diode. Test for LEAKAGE in uppermost and second positions (GREEN BASE) of TEST switch. One position will read full scale, while the other will give a lower reading depending on the shunting effect of the circuitry. If both positions produce full scale readings, the diode is either shorted or heavily shunted by low resistance circuitry; for example, a transient suppressor diode across a relay or solenoid coil. In this case the diode should be disconnected from the circuit and retested.

D. "Hands Off" Testing

When the base lead of devices being tested can be identified, leave the test switch in the uppermost position. The transistors can then be probed one by one by connecting the green lead to the base, and the blue and yellow leads to the collector and emitter respectively. The audible tone will tell you when the transistor is good. Occasionally, the collector and emitter leads may have to be interchanged to produce a tone.

The "Hands Off" method is useful when it is necessary to test a number of transistors in a circuit, or when it is impossible to connect all three leads to the device being tested: If one lead can be clipped on the device, both hands are free to probe the remaining two leads. With this feature, you can also use the B & K-Precision DYNAFLEX MODEL FP-5 PROBE (optional) to test devices from either side of the P.C. board.

E. Intermittent Testing

Often the Model 520B can be used to identify intermittent transistors in a circuit. Connect the test leads to the suspected transistors and move the TEST switch until the tone is heard. Then, leaving the 520B in this position, the transistor can be subjected to various physical tests such as tapping, heating, or cooling. An intermittent transistor will show up as an intermittent tone.

HINT: A can of "Instant Cold Spray" is quite useful for providing rapid cooling of discrete components.

OUT-OF-CIRCUIT TESTING

A. Transistors

1. Set the DRIVE switch to the LO position.

2. Connect the three test leads to the device or plug it into the convenient test socket on the Model 520B panel (no need to worry about lead identification).

3. Slowly move the TEST switch until the 520B indicates a good transistor and produces an audible tone. Leave the TEST switch in this position and identify all the leads of the transistor by the colors shown in the Lead Identification Window. In LO drive, the transistor should test good in only *one* TEST switch position (see "THINGS TO KNOW ABOUT THE 520B").

4. If no tone is heard as the TEST switch is slowly moved through its six positions, in LO drive, then the device under test is one of the following:

   a. Transistor with high leakage or very low gain (may not function properly in-circuit).

   b. Transistor with open/shorted elements.

   c. Device is an FET. If this can be verified from available service information, retest as outlined below.

   d. Device is a power Darlington which requires high base voltage. If this can be verified from service information available, retest using HI drive.

5. A transistor which tests *good* can be further evaluated for leakage and material identification.

6. LEAKAGE TESTS. Set DRIVE switch to HI. Move the TEST switch to a position which produces a good indication and turn the function switch to LEAKAGE and note the meter indication. Hold the function switch in LEAKAGE position and move the TEST switch to the other position which displays the same BASE color in the Lead Identification Window. The leakage should be about equal in both TEST positions, and within the limits shown on the meter scale, In one of the positions the meter indicates I_{CES}; in the other I_{BES}.

7. IDENTIFICATION OF TRANSISTOR TYPES: If the type of transistor is not known, turn the function switch to IDENTIFY position and the Model 520B will indicate whether the device is SILICON (yellow LED glows) or GERMANIUM (green LED glows). The leakage indicated can then be compared to the proper limits marked on the meter face. The meter leakage scales are color-keyed to the LED IDENTIFY indicators.

B. FET's

1. Set the DRIVE switch to the HI position.

2. Slowly move the TEST switch until the 520B indicates a good FET.

3. J-FET's will indicate good in *two* adjacent TEST switch positions which have the same BASE color. (Most J-FET's are symmetrical.)

4. The BASE color shown in the Lead Identification Window is the *gate.*

5. If no audible tone is heard then the FET under test is defective.

6. A FET which tests *good* can be further evaluated as indicated in the following steps.

7. I_{DSS} LEAKAGE. Move the TEST switch to a position which produces a good indication, then turn the function switch to LEAKAGE. The meter will read I_{DSS}. Note that the I_{DSS} of FET's can range from a few microamperes to several milliamperes, and in some cases will read off scale on the 502B.

8. FET GATE LEAKAGE. Drain-to-gate or source-to-gate leakage of either N-Channel or P-Channel FET's can be tested by treating the gate junction as a diode. First, locate the gate lead by moving the TEST switch through each of its six positions until the tone is heard. The *gate* lead is the BASE color which appears in the Lead Identification Window. Then connect the FET gate to the blue test clip and one or both of the remaining FET leads to the yellow test clip. Move the TEST switch through the uppermost and second positions (GREEN BASE) and check for leakage. The leakage should be zero in one of the positions if the device is a J-FET, or both positions if it is a MOS-FET.

9. N-Channel FET drain or source-to-gate leakage can be measured in another way. Leave the FET connected to the three test leads. Put the TEST switch in any position which does not indicate good. Then, holding the FUNCTION switch in the LEAKAGE position, move the TEST switch through all six positions and watch the meter. If the device is good, the meter will indicate zero current in two of the six positions. P-Channel FET's must be measured as diodes, as described above.

10. DEPLETION MODE FET'S. Drain-to-source leakage of depletion mode FET's cannot be measured reliably by the Model 520B, as this requires that the gate be reverse-biased while testing. Merely disconnecting the gate lead leaves the device subject to stray pickup and/or leakage currents, and with the extremely high gate impedance there is no way of assuring that the gate will pinch off.

11. ENHANCEMENT MODE FET's. Enhancement mode FET's can be tested in the same way as transistors.

C. Diodes

1. LEAKAGE. Connect the blue and yellow test leads to the two ends of the diode. Hold the function switch in the LEAKAGE position while moving the TEST switch through the two green BASE positions. If the diode is good the meter will indicate full scale in one position and will indicate zero or some low value in the other. The low reading is the LEAKAGE current of the diode.

2. LEAD IDENTIFICATION. The anode and cathode leads of the diode can be identified. Connect the blue and yellow test leads to the diode leads. While holding the function switch in the LEAKAGE position, move the TEST switch to whichever of the two green BASE positions produces a full scale reading. The diode *cathode* is connected to the test lead color indicated as the COLLECTOR in the Lead Identification Window.

D. SCR's

1. Set the DRIVE switch to the HI position.

2. SCR's will indicate NPN in one TEST switch position and PNP in another position that does not have the same BASE color as shown in the Lead Identification Window.

3. The SCR is good *only* if all the following are obtained:

   a. One NPN indication.

   b. One PNP indication.

   c. Indications must not have same BASE color.

   LEAD IDENTIFICATION:

   a. BASE color is *gate* lead when the NPN lamp glows.

   b. BASE color is *cathode* lead when the PNP lamp glows.

HOW THE 520B WORKS

TEST SWITCH

1. The 520B transistor tester uses a six-position lever switch located at the right side of the panel to connect the device being tested in the correct manner for testing. As this switch is moved from top to bottom, the device connected to the three test leads, or plugged into the socket, is connected in all possible configurations to the testing circuit. The uppermost position is the "normal" connection, in that the socket is connected in standard triangle configuration to the testing circuits and the blue, green and yellow leads are connected to the collector, base and emitter circuits respectively.

2. In two of the six positions, using HI drive, the device is connected properly for testing. This is true since almost all transistors have gain, although usually very little, when the collector and emitter are interchanged, and most junction FET's are symmetrical. These two positions are always adjacent, and always display the same base color in the Lead Identification Window whenever the 520B is indicating a good device.

3. In LO drive, a transistor should indicate good in only one switch position since limited base drive allows the detector to test the transistor as a good device in only its high gain connection.

GAIN TEST CIRCUIT

4. The 520B circuitry generates a continuous series of pulses specially designed to periodically test a transistor about ten times per second. These short, high-current pulses apply a voltage pulse to the collector, first positive for testing NPN devices, followed by negative for testing PNP (see Fig. 2a). During this pulse, a shorter pulse of the same polarity is applied to the base of the device which drives the collector voltage toward saturation. Taking a closer look at the basic pulse circuitry, refer to Fig. 2. T1 is the period clock, which runs at approximately 10 Hz. It initiates each test period while simultaneously resetting FFl and FF2. T2 runs at 1000 Hz and controls the pulse-forming circuits.

5. The pulse-forming circuit uses a combination of toggles and RS flip-flops to produce the proper sequence of pulses for the collector drive circuit A and the base drive circuit B. A and B are level-shifting complementary drivers which can deliver several hundred milliamperes at +5V and −5V or return to zero volts.

6. A properly connected NPN transistor, as shown above, will see the waveform at Fig. 2A, and its base will see the waveform at Fig. 2B. Note that during the

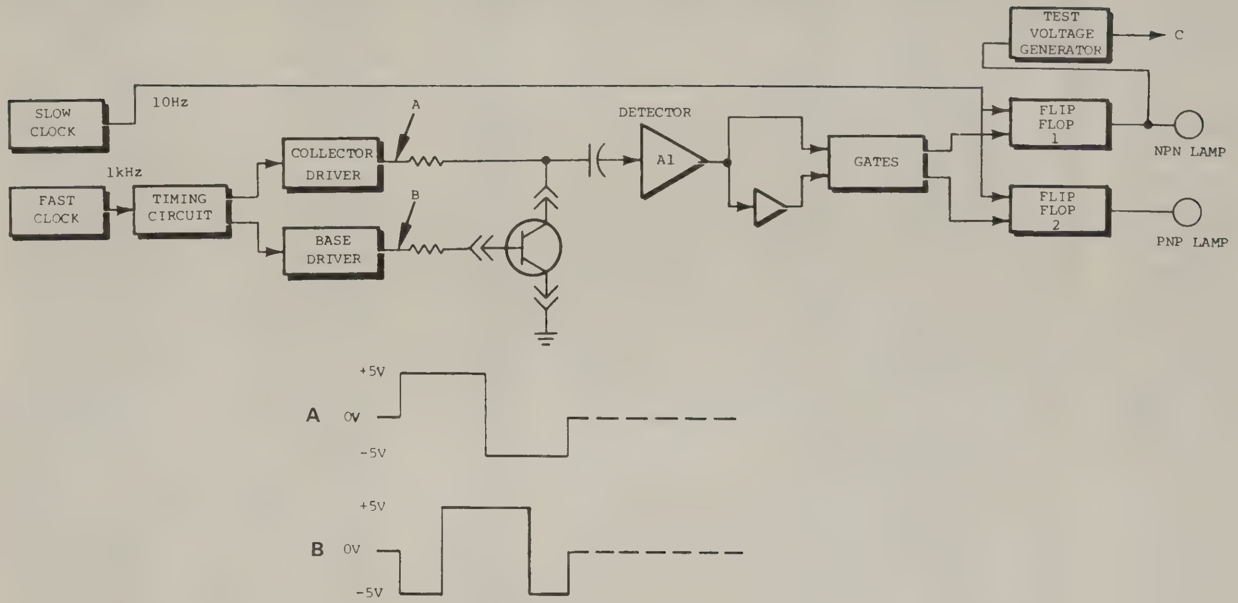

Fig. 2. Block diagram.

positive excursion of the collector voltage, the base is driven first negative and then positive. If the transistor being tested is NPN, the collector voltage will drop abruptly when its base is driven positive. This negative-going transition, which can only occur if transistor action is present, is differentiated and the differentiated signal is used to latch flip-flop 1.

If a PNP transistor is tested, the turn-on transition occurs in the second half of the waveform 2A, and in the opposite direction.

The PNP output pulse is inverted in order to have the proper polarity to operate flip-flop 2. Of course, other pulses appear at the differentiator output, since all voltage transitions are similarly differentiated, but the synchronized gating circuits prevent the unwanted pulses from reaching the lamp driving flip-flops and thus eliminating wrong indications.

The input to FF1 is only enabled during the time period in which an NPN device can be detected and similarly, FF2 is only enabled when a PNP device can be detected. Only the flip-flop which corresponds to the type of device being tested can be latched, lighting the lamp corresponding to that device.

In addition to being connected to the LED's on the panel, both outputs are connected through an OR gate to activate the audible tone if either of the latches operate. Thus, if the basing and polarity of a device is unknown, the TEST switch can be moved from position to position until the tone is heard.

It is then left in that position and the polarity of the device is indicated by one of the PNP-NPN lamps on the 520B panel. If the switch is left in this position, the circuitry is then set up to make several additional out-of-circuit tests on the transistor.

The output of FF1 is either +5V or 0, depending on whether the device tested was PNP or NPN. This output in turn drives another level-shifting complementary circuit which produces either +5V or −5V, but always at the correct polarity to further test the same device. When not testing, this voltage is always left at −5, to be available for diode testing.

CURRENT METER

7. The 520 is equipped with a special non-linear meter circuit to measure I_{CES} and I_{BES}. When the FUNCTION switch is turned to LEAKAGE, two things happen. First, the reset pulse is inhibited from FF1 and FF2. This leaves FF1 in the state in which it was while "Gain Testing" the transistor. FF1 in turn, through the test generator, produces the correct output voltage for testing at point (C), + for NPN or − for PNP.

Second, the switch connects the collector to this supply, and and the base and emitter to the current meter circuit. The meter circuit is designed for essentially zero voltage drop at its terminals so that the device is always tested at the proper voltage, and is made non-linear to measure a very wide range of currents on a single scale.

IDENTIFICATION CIRCUIT

8. When switching to IDENTIFY, the flip-flop reset circuit is inhibited as before to lock the test voltage in the proper polarity. The base-emitter junction is then current-fed, and connected to a special voltage comparator which produces a +5 output for a Base-to-Emitter voltage above approximately ±.5V, or zero output for B-E voltage less than ±.5V. The output drives one of two LED's, depending on its state, indicating either silicon, which always produces more than .5V drop, or germanium, which seldom produces more than .4V drop. The LED's are enabled only when a good test is performed, and only when the switch is in the IDENTIFY position.

OPERATIONAL TESTS

1. To ensure that the 520B is operating according to specifications, test for proper output drive power. This can be done easily by building the simple circuit in Fig. 3. The 520B must be switched to the HI drive position. Transistor should check good in only *one* TEST switch position.

2. To test the LO drive function of the 520B, eliminate R1 and replace R2 with a 1.5kΩ resistor in Fig. 3. The transistor should check good in only *one* TEST switch position.

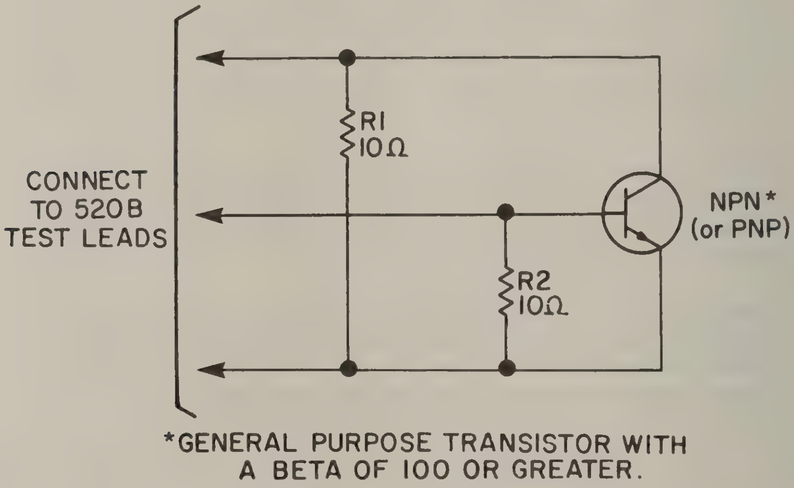

Fig. 3.

CALIBRATION AND SERVICE

1. **Meter Calibration.** The only part of the 520B which may require calibration is the leakage current meter. The following procedure should be followed:

    a. Turn off the 520B. If the meter does not indicate zero, insert a screwdriver in the hole on the front panel just below the meter and adjust it to indicate zero.

    b. Remove the back of the instrument by removing the five screws at the bottom and rear of the case. Locate TP1 near the top center of the P.C. board. Connect TP1 to the metal chassis with a jumper. Turn on the 520B. If the meter is not indicating zero, adjust the ZERO control with a screwdriver through the left side hole in the top of the chassis until the meter balances. The zero control is identified on the P.C. board just below the adjustment hole (see Fig. 4). Remove the jumper.

    c. To calibrate the meter, put the TEST switch in the uppermost (green) position. Connect a 2000Ω potentiometer and a 0-5mA meter in series from the yellow jack to the blue jack as in Fig. 4. Then while holding the FUNCTION switch in the LEAKAGE position, adjust the potentiometer for 5 milliamperes in the external meter. If the meter on the 520B panel does not read full scale, adjust the "CAL" control through the right side hole in the top of the chassis. The CAL pot is identified on the P.C. board just below the adjustment hole. See Fig. 4.

2. **520B Power Supply Voltages.** Can be measured at the points marked +5 and −5 and GND on the lower right hand corner of the P.C. board. they must be between 4.7 and 5.3V for proper operation.

3. **Observation of Waveforms.** The waveform applied to the collector and base of the device under test can be observed with an oscilloscope connected to the jacks on the 520B panel. Leave the TEST switch in the uppermost position as above, and place a 1kΩ to 10kΩ resistor between the yellow jack and the green jack. Connect the scope ground to the yellow jack (emitter) and the vertical input to the green jack (base). The base waveform should be as shown in Fig. 2b. Connect the resistor between yellow and blue jacks. Connecting the vertical input to the collector jack (blue) should produce the waveform shown in Fig. 2a. A dual trace oscilloscope is especially convenient for observing both waveforms simultaneously.

If the line fuse blows, it must be replaced with a 1/16A, 3AG Slow-Blow fuse. Remove the back cover, as in "CALIBRATION". Remove the right end panel of the case (the side nearest the "TEST" switch). The fuse is found on the P.C. board near the power transformer. It is unlikely that the fuse will blow without some accompanying circuit failure. Look for shorted rectifier diodes (D1-D4) or input filter capacitors (C1 and C2).

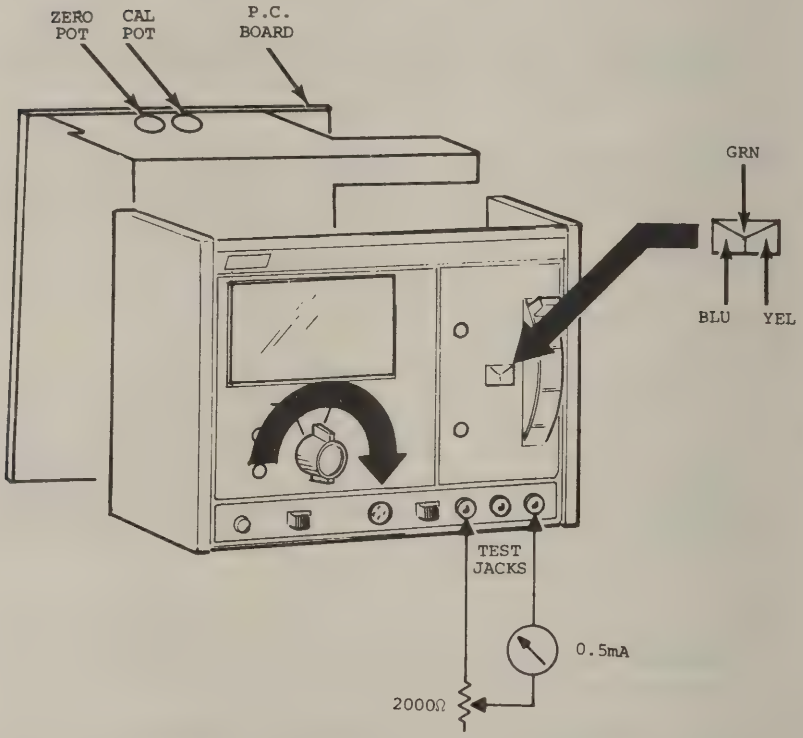

Fig. 4. Location of calibrating controls.

WARRANTY SERVICE INSTRUCTIONS

1. Refer to the MAINTENANCE section of your B & K-Precision instruction manual for adjustments that may be applicable.

2. Defective parts removed from units which are within the One Year Limited Warranty period should be sent PREPAID to the Service Department listed below. Be sure to state the model and serial number of the unit from which the parts were removed and date the unit was purchased. These parts will be exchanged at no charge, under the terms of the Warranty.

3. If the above-mentioned procedures do not correct the problem you are experiencing with your unit, pack it securely (preferably in the original carton or double-packed). Enclose a letter describing the problem and include your name and address. Deliver to, or ship PREPAID (UPS preferred) to the nearest B & K-Precision authorized service agency (see list enclosed with unit).

If your list of authorized B & K-Precision service agencies has been misplaced, contact your local distributor for the name of your nearest service agency, or write to:

Service Department

B & K-Precision Product Group
DYNASCAN CORPORATION
2815 West Irving Park Road
Chicago, Illinois 60618

LIMITED ONE-YEAR WARRANTY

DYNASCAN CORPORATION warrants to the original purchaser that its B & K-PRECISION product, and the component parts thereof, will be free from defects in workmanship and materials for a period of one year from the date of purchase.

DYNASCAN will, without charge, repair or replace, at its option, defective product or component parts upon delivery to an authorized B & K-PRECISION service contractor or the factory service department, accompanied by proof of the date of purchase in the form of a sales receipt.

To obtain warranty coverage, this product must be registered by completing and mailing the enclosed warranty registration card to DYNASCAN, B & K-PRECISION, P.O. Box 35080, Chicago, Illinois 60635 within five (5 days) from the date of purchase.

Exclusions: This warranty does not apply in the event of misuse or abuse of the product or as a result of unauthorized alterations or repairs. It is void if the serial number is altered, defaced or removed.

DYNASCAN shall not be liable for any consequential damages, including without limitation damages resulting from loss of use. Some states do not allow limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

This warranty gives you specific rights and you may also have other rights which vary from state to state.

For your convenience we suggest you contact your B & K-PRECISION distributor, who may be authorized to make repairs or can refer you to the nearest service contractor. If warranty service cannot be obtained locally, please send the unit to B & K-PRECISION Service Department, 2815 West Irving Park Road, Chicago, Illinois 60618, properly packaged to avoid damage in shipment.

B+K PRECISION DYNASCAN CORPORATION

TEST EQUIPMENT PRODUCT GROUP
DYNASCAN CORPORATION
2815 W. Irving Park Road, Chicago, Illinois 60618
PHONE: 312/583-4360

FACTORY-AUTHORIZED PARTS & SERVICE CENTERS

492 – 036 – 0 – 180

NOTE

This list is subject to change without notice. Please contact the Service Center BEFORE forwarding equipment for repair.

The following Authorized Service Centers will handle any parts and/or service problems, either in or out of warranty. Each facility has been selected for the *quality* and *promptness* of its service. We urge you to take advantage of these excellent service facilities, which have been established to serve *your* needs.

EFFECTIVE DATE: January 1, 1980

ALABAMA

Arnold's Instrument Service
3258 Springhill Avenue
Mobile, AL 36607
205/478-4610

ARIZONA

Arizona Certified Electronics
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Tucson, AZ 85719
602/623-2432

ARKANSAS

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Fayetteville, AR 72701
501/442-0675

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501/782-4446

Electronic Sales & Service
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303/936-8378

Clyde N. Still Electronics
2630 W. Kiowa
Colorado Springs, CO 80904
303/633-8404

CONNECTICUT

L & L Electronics
186 N. Main Street
Branford, CT 06405
203/488-4814

FLORIDA

Palmer Electric Company
875 Jackson Avenue
Winter Park, FL 32789
305/644-8561 ext. 279

IDAHO

Gunter Plastics & Electronics
953 A. South Main Street
Pocatello, ID 83201
208/232-3604

Idaho Instrument Service
624 4th Avenue, West
P.O. Box 793
Twin Falls, ID 83301
208/733-5636

ILLINOIS

Dynascan Corporation
2815 W. Irving Park Road (WALK-IN)
Chicago, IL 60618
312/583-4360

Dynascan Corporation
6460 W. Cortland Street (SHIP TO)
Chicago, IL 60635

INDIANA

Electro-Lab Services, Inc.
1302 N. Fulton Avenue
Evansville, IN 47712
812/423-5211

KANSAS

Main Electronics, Inc.
225 Ida Street
Wichita, KS 67211
316/267-3581

KENTUCKY

Louisville Meter Service
No. 2 Bon-Air Shopping Center
Louisville, KY 40220
502/454-3432

MASSACHUSETTS

Bay State TV & Appliance Corp.
1570 Acushnet Avenue
New Bedford, MA 02746
617/992-2044

MICHIGAN

Electro Instrument Repair
Division, Instrument Specialties, Inc.
1024 West 14 Mile Road
Clawson, MI 48017
313/435-3311

Main Electronics
5558 S. Pennsylvania Avenue
Lansing, MI 48910
517/882-5035

MINNESOTA

Instrumentation Services, Inc.
957 Winnetka Avenue, North
Minneapolis, MN 55427
612/544-8916

MISSOURI

G & M Electronics, Ltd.
R.R. #1 Hwy. 61 South
LaGrange, MO 63448
314/655-2201

Kermit Shetley Repair
2031 Woodland Hills Drive
Cape Girardeau, MO 63701
314/334-2055

Scherrer Instruments
7170 Manchester Avenue
St. Louis, MO 63143
314/644-5362

NEBRASKA

Alpha-Omega Applied Electronics, Inc.
2208 Franklin Street
Bellevue, NE 68005
402/292-6300

Bob's Industrial Electronics
1720 N. Sherman
North Platte, NE 69101
308/532-8017

Electrometrics Company
404 South 11th
Lincoln, NE 68508
402/477-3434

Midwestern Service Labs
8998 L Street, Suite 233
Omaha, NE 68127
402/331-2906

NEW JERSEY

Ampower Electronic Inst., Co., Inc.
26 Just Road
Fairfield, NJ 07006
201/227-7720

NEW YORK

Circle Tele-Tronics, Inc.
1008 Utica Avenue
Brooklyn, NY 11203
212/345-5656

Electronic Instrument Co.
325 Mt. Read Boulevard
Rochester, NY 14606
716/328-4350

Trott Electronics
9020 Wehrle
Clarence, NY 14031
716/634-8500

NORTH CAROLINA

Speed Instrument
Division Owen-Barbot, Inc.
Hwy. #401 North, Box 11456
Raleigh, NC 27604
919/876-4919

OHIO

Pioneer Cleveland Division
Pioneer-Standard Electronics, Inc.
4800 E. 131st Street
Cleveland, OH 44105
216/587-3600

Pioneer Dayton Instrument Lab
1900 Troy Street
Dayton, OH 45404
513/236-9900

OKLAHOMA

Central Instrument Laboratory, Inc.
720 N.E. 63rd Street
Suite 104
Oklahoma City, OK 74145
405/525-2253

Central Instrument Laboratory, Inc.
9920 E. 42nd Street
Suite 112
Tulsa, OK 74145
918/492-8829

OREGON

Ralston-Clearwaters Electronics
838 Southside Road
Grants Pass, OR 97526
503/862-2093

SOUTH CAROLINA

Greenton, Inc.
4 Newland Avenue
Greenville, SC 29609
803/232-3889

King's
114 S. Main Street
Bishopville, SC 29010
803/484-5482

TEXAS

Border Electronic Services, Inc.
1704 E. Paisano
P.O. Box 3804
El Paso, TX 79923
915/532-2524

Central Instrument Laboratory
777 S. Central Expressway
Suite 2A
Richardson, TX 75080
214/234-2862

Champion Instrument Laboratory
624 S. Tatar Road
P.O. Box 3381
Pasadena, TX 77506
713/473-6680

The Measurements Company
11105 Bellaire Boulevard
Suite 39
Houston, TX 77072
713/498-7478

Osmond Associates
1716 E. Yandell
El Paso, TX 79902
915/542-0024

Rhodes-Groos Laboratories, Inc.
3409 Andtree Boulevard
Austin, TX 78724
512/926-0813

Whitlock Instrument
1306 North Texas Street
Odessa, TX 79762
915/337-3412

UTAH

Computer Terminal Repair
3641 Wellington Street
Salt Lake City, UT 84106
801/486-5540

Salt Lake Instruments Service
129 W. 17th South
Salt Lake City, UT 84115
801/487-2541

WASHINGTON

B & F Repair
East 15110 Sprague Avenue
Veradale, WA 99037
509/926-9037

Eicher-Richards Company
2727 N.E. Blakeley Street
Seattle, WA 98105
206/523-7888

The Lectronic Shoppe
202 W. Main Street
Everson, WA 98247
206/966-3621

Northwest Electronics
7005 24th N.W.
Seattle, WA 98117
206/783-1479

Sutherlands, Inc.
952 Industry Drive
Building 26
Tukwila, WA 98188
206/575-4075

WISCONSIN

Electro-Mechano Company
241 E. Erie Street
Milwaukee, WI 53202
414/272-4050

INTERNATIONAL TEST EQUIPMENT WARRANTY STATIONS

AUSTRALIA

Parameters, PTY, Ltd.
68 Alexandria St.
Crows Nest, N.S.W.
Australia 2065
02/439-3288

REPUBLIC OF PANAMA

Tropelco S.A.
Box 8465
Panama 7, Republic of Panama
23-1285, 6157

SOUTH AMERICA

Electronica Tarbay
Av. Soublette No. 21
San Bernardino
Caracas 101 Venezuela, South America
51-37-33

Teleroman CIA LTDA
10 de Agosto 614 y Boyaca
Guayaquil, Ecuador, South America
513--525 Casilla 3906

WEST GERMANY

Dynatrade Import-Export
Schimmelbuschstr. 25
4006 Erkrath 2, West Germany
02104-31147

WARRANTY SERVICE INSTRUCTIONS

1. Refer to the MAINTENANCE section of your B & K-Precision instruction manual for adjustments that may be applicable.

2. If the above-mentioned procedures do not correct the problem you are experiencing with your unit, pack it securely (preferably in the original carton or double-packed). Enclose a letter describing the problem and include your name and address. Deliver to, or ship PREPAID (UPS preferred) to the nearest B & K-Precision authorized service agency (see list enclosed with unit).

If your list of authorized B & K-Precision service agencies has been misplaced, contact your local distributor for the name of your nearest service agency, or write to:

Service Department

B & K-Precision Product Group
DYNASCAN CORPORATION
6460 West Cortland Street
Chicago, Illinois 60635

LIMITED ONE-YEAR WARRANTY

DYNASCAN CORPORATION warrants to the original purchaser that its B & K-PRECISION product, and the component parts thereof, will be free from defects in workmanship and materials for a period of one year from the date of purchase.

DYNASCAN will, without charge, repair or replace, at its option, defective product or component parts upon delivery to an authorized B & K-PRECISION service contractor or the factory service department, accompanied by proof of the date of purchase in the form of a sales receipt.

To obtain warranty coverage, this product must be registered by completing and mailing enclosed warranty registration card to DYNASCAN, B & K-PRECISION, 6460 West Cortland street Chicago, Illinois 60635 within fifteen (15) days from the date of purchase.

Exclusions: This warranty does not apply in the event of misuse or abuse of the product or as a result of unauthorized alterations or repairs. It is void if the serial number is altered, defaced or removed.

DYNASCAN shall not be liable for any consequential damages, including without limitation damages resulting from loss of use. Some states do not allow limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

This warranty gives you specific rights and you may also have other rights which vary from state to state.

For your convenience we suggest you contact your B & K-PRECISION distributor, who may be authorized to make repairs or can refer you to the nearest service contractor. If warranty service cannot be obtained locally, please send the unit to B & K-PRECISION Service Department, 6460 West Cortland Street, Chicago, Illinois 60635, properly packaged to avoid damage in shipment.

B+K PRECISION DYNASCAN CORPORATION

6460 West Cortland Street
Chicago, Illinois 60635

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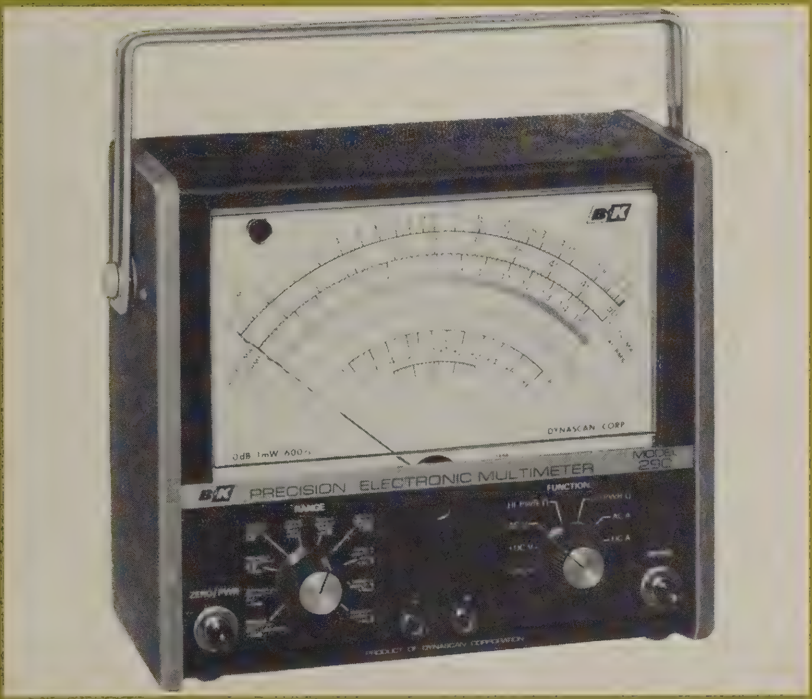
INSTRUCTION MANUAL

B&K Model 290

EXTENDED-RANGE SOLID-STATE ELECTRONIC MULTIMETER


B&K
DYNASCAN CORP
0dB 1mW 600Ω
MODEL 290
B&K PRECISION ELECTRONIC MULTIMETER
RANGE
FUNCTION
ZERO/PWR
PRODUCT OF DYNASCAN CORPORATION

B&K
Product of DYNASCAN CORPORATION
1801 West Belle Plaine Avenue, Chicago, Illinois 60613

Dear Friend:

Congratulations on your purchase of B & K—Precision Test Equipment, and welcome to the B & K family. We hope your experience with your new test equipment will make you a lifetime B & K customer.

Your instrument is backed by more than 20 years of experience in designing and manufacturing. Our most important goal is your satisfaction. At B & K, test equipment is made to meet the demands of the field focusing on dependability and accuracy. We also concentrate on simplicity and operating ease with features that reduce the possibility of human error and speed the servicing process.

In order to determine the type of test units that are needed we have been guided by letters and reports from technicians and engineers who use the equipment daily. Our field tests and studies have helped provide better and faster service techniques. Close contact has been maintained with the manufacturers of consumer products which our test units will be checking and trouble-shooting.

Key personnel in our company cut their eye teeth in the TV service business. This is why we have more "sensitivity" for the problems and conditions under which the test equipment will be used.

B & K product designs are constantly reviewed, and refinements are made or new models developed to meet advances in our industry and to fill your needs. We set our standards high so you can be assured that the B & K test instruments you buy represent advanced design, quality construction, and dependable long-term performance at a price you can afford.

If you have any comments or thoughts about our products, or test equipment in general, I would be delighted to hear from you.

Thanks for your confidence in B & K and we look forward to serving you for a long time to come.

Sincerely,

Carl Korn

Carl Korn
President

INSTRUCTION MANUAL

FOR

Model 290

EXTENDED-RANGE, AC-OPERATED SOLID-STATE ELECTRONIC MULTIMETER

B & K *DIVISION OF DYNASCAN CORPORATION*
1801 West Belle Plaine Avenue
Chicago, Illinois 60613

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GENERAL DESCRIPTION AND SPECIAL FEATURES

The B & K Model 290 is a solid state FET input Electronic Multimeter ideally suited for radio and TV service technicians, industrial users, engineers and hobbyists.

Its main features include:

- High input impedance (15 megohms) on both AC and DC voltage measurements for minimum circuit loading.
- 50 millivolts full-scale sensitivity on both AC and DC volts.
- Special low resistance ohms range (one ohm center scale).
- Low voltage and normal voltage ohms tests for measuring resistances or for testing IC's, transistors, SCR's, etc. in or out-of circuit.
- Full AC operation (no batteries) with regulated power supplies for ultra stable operation.
- Protection from accidental overloads to meter, FET's and other circuit elements.
- Easy-to-read meter with mirrored scale for making exact measurements.

SPECIFICATIONS

DC VOLTS:	
10 Ranges:	50mV, 150mV, 500mV, 1.5V, 5V, 15V, 50V, 150V, 500V and 1500V full scale.
Accuracy:	± 1.5% full scale.
Input Resistance:	15 Megohms, ± 1.5% including 100K isolating resistor in probe.
Normal Mode Rejection:	Better than 46 dB @ 60 Hz for ± 2% accuracy change.
AC VOLTS:	
10 RMS Ranges:	50mV, 150mV, 500mV, 1.5V, 5V, 15V, 50V, 150V, 500V and 1500V full scale.
10 Peak-to-Peak Ranges:	140mV, 440mV, 1.4V, 4.4V, 14V, 44V, 140V, 440V, 1400V and 4400V full scale.
Input Impedance:	14.9 Megohms shunted by approximately 41pf at input jacks. (140pf with PR-21 Probe).
Frequency Response:	±.5dB, 20Hz to 500kHz to 150V ± 3dB, 5Hz to 750kHz to 150V ± 3dB, 5Hz to 20kHz over 150V
Accuracy:	± 3% full scale @ 60Hz, ± 5% on 500V and 1500V ranges.
Common Mode Rejection:	Better than 40 dB @ 60Hz.

OHMS MEASUREMENT:

8 Low Voltage Ranges (33mV):	RX0.1, RX1, RX10, RX100, RX1K, RX10K, RX100K, RX1M.
7 Normal Voltage Ranges (1.25V):	RX1, RX10, RX100, RX1K, RX10K, RX100K, RX1M.
Midscale Reading:	10 (times multiplier)
Accuracy:	±3° of arc, (±4° of arc on RX0.1 and RX1M ranges).

DC CURRENT:

10 Ranges:	50μA, 150μA, 500μA, 1.5mA, 5mA, 15mA, 50mA, 150mA, 500mA and 1.5 Amp full scale.
Accuracy:	± 3% full scale; ± 4% on 1.5 Amp Range.
Internal Voltage Drop:	50mV at instrument input terminals, to 50mA range.

AC CURRENT:

10 Ranges:	50μA, 150μA, 500μA, 1.5mA, 5mA, 15mA, 50mA, 150mA, 500mA, and 1.5 Amp full scale.
Accuracy:	± 4% full scale @ 60Hz, ± 5% on 50μA and 1.5 amp ranges.
Internal Voltage Drop:	50mV, at instrument input terminals, to 50mA range.
Frequency Response:	±.5dB, 20Hz to 5kHz, 500uA to 150mA ranges. ±3dB, 7Hz to 16kHz, 500uA to 150mA ranges.

DECIBEL (dB):

10 Ranges:	–40 to +66.
Accuracy:	± 3% of full scale.
Reference:	1mW into 600 ohms. (.775V)

RESISTORS:

Multipliers :	½% Precision Type – Frequency-compensated.
Current Shunts:	1% Precision Type
Ohms Shunts :	2% Precision Type

METER:	7", 100μA, ± 2%, 100°. DC zero center scale. Mirrored scale.

PROTECTION:	Meter and FET input protected by diode from overloads. Circuit overload protection by fuse (1.25 Amp). High Voltage protection by spark gaps. Power line fuse: 1/16 amp, 3AGSB.
SEMICONDUCTORS:	(1) Dual N-Channel FET. (1) NPN Dual Transistor. (1) NPN Signal Transistor. (1) NPN Low Power Transistor. (2) Germanium Diodes. (2) Silicon Diodes. (4) Silicon Rectifiers (2) Zener Diodes.
POWER REQUIREMENTS:	105 – 125 VAC, 50/60Hz; 3.9 Watts.
DIMENSIONS:	7-1/4" H. x 8" W. x 3-5/8" D.
WEIGHT:	4-1/4 lbs.

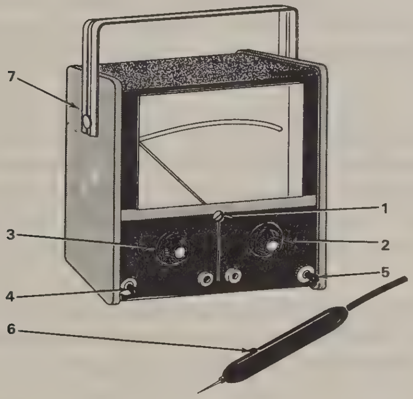


Figure 1. Operating Controls

OPERATING CONTROLS

This Electronic Multimeter is as simple to operate as a conventional VTVM. The following is a brief description of each control and how it is used (refer to Figure 1).

1. METER ZERO ADJUST (MECHANICAL): The mechanical meter zero adjustment must be made before the instrument is turned on. Insert a screwdriver (preferably non-metallic) into the slot located in the center of the front panel immediately below the meter face. While gently tapping meter, very slowly turn the mechanical zero adjust until the pointer rests at zero.
2. FUNCTION SWITCH: Used to select the desired function for the measurements to be performed.
3. RANGE SWITCH: Used to select the desired range of current, voltage, or resistance to be measured.
4. OFF-ON SWITCH AND ZERO CONTROL: To turn the meter on, pull the ZERO control shaft outward. The red lamp on the meter will glow, indicating the meter is ON. Rotate the ZERO control to position the pointer of the meter at zero on the meter scale or to position the pointer on the zero center when using this feature. Push the ZERO control shaft in to turn the meter OFF.
5. OHMS CONTROL: The OHMS control is adjusted with the FUNCTION switch in one of the OHMS positions and with the test leads open. Rotate the OHMS control for a full scale indication, infinity (∞) on the ohms scale of the meter.
6. PROBE SWITCH: This instrument is equipped with a shielded test lead to allow accurate AC measurements in the presence of strong electrical fields. When the switch is in the 100K position, a 100K resistor is switched in series with the test lead. This isolates the cable capacity from the circuit under test when making DC voltage measurements in RF, IF or sweep circuits. Set the probe switch to the DIRECT position for all measurements other than DC voltage.
7. ADJUSTABLE HANDLE: The carrying handle may be used to support the instrument in a convenient sloping position for easy viewing. The case also can be placed in either a vertical or horizontal position.

OPERATING THE MODEL 290

SAFETY PRECAUTIONS

A certain amount of danger is always present when working on electrical equipment and therefore, the user is cautioned to always familiarize himself as much as possible with the equipment to be tested, before any work is performed. It should be kept in mind that high voltages often appear at unexpected points in defective equipment.

When testing high voltage circuits, develop the habit of keeping one hand in your pocket to minimize the hazard of accidental shock. It is also important to have a properly insulated floor or floor covering to stand on while taking measurements. Be particularly careful to avoid contacting nearby objects which could provide a ground return path. A good practice is to remove operating power before connecting test leads. AN ISOLATION TRANSFORMER SHOULD ALWAYS BE USED IN EQUIPMENT HAVING THE CHASSIS TIED TO ONE SIDE OF THE A-C POWER LINE.

1. PREPARATION FOR MAKING MEASUREMENTS:
   a. With the ZERO control knob pushed in (meter in the OFF position), check to see that the meter pointer rests over the zero mark on the left side of the scale. If the pointer is off zero, reset the meter zero adjust (mechanical, as explained under OPERATING CONTROLS).
   b. Insert the double banana plug of the test lead assembly into the meter terminal receptacles so that the positive (+) pin of the plug is in the red (+) terminal.
2. MEASURING DC VOLTAGES:
   a. Turn the FUNCTION switch to the –DC V or +DC V position, depending on the polarity of the voltage to be measured.
   b. Set the PROBE switch to 100K.
   c. Pull the ZERO control shaft outward and rotate ZERO control until meter pointer rests over the zero mark on VOLTS/MA scale.
   d. When measuring an unknown voltage, set the RANGE switch fully clockwise.
   e. Connect the black (negative) lead of the test lead assembly to ground or reference point of the circuit under test. Bring the probe tip in contact with the point to be measured.
   f. Observe the instrument reading; if the meter pointer deflects to the left, set the FUNCTION switch to the correct polarity.
   g. The DC voltage is read on the two black scales just above the mirrored scale on the meter. The top DC scale is used with the 50mV, 500mV, 5V, 50V and 500 Volt ranges. The second DC scale is used for the 150mV, 1.5V, 15V, 150V and 1500 volt ranges. The 0 to .5 volt scale is read directly for the .5 volt range, and is multiplied by .1, 10, 100 and 1000 for the 50mV, 5V, 50V and 500V ranges respectively. The 0 to 1.5 volt scale is read directly for the 1.5 volt range and multiplied by .1, 10, 100 and 1000 for the 150mV, 15V, 150V and 1500 volt ranges respectively.
3. ZERO CENTER DC VOLTAGES:
   a. Set the FUNCTION switch to +DC V and short the test leads together.
   b. Rotate the ZERO control knob clockwise until the meter pointer rests over the center zero mark (the bottom scale).
   c. Set the PROBE switch to 100K.

d. Set the RANGE selector switch fully clockwise and connect the test leads to the circuit the same as for DC voltage measurement.

e. Observe the meter pointer indication on the black scale marked "O" and rotate the RANGE switch counterclockwise to obtain the best useable meter deflection. Positive voltages will make the pointer deflect to the right of the center zero mark. Each side of the scale represents one-half of the range being used. For example, when the .5 volt range is being used, each half of the scale represents .25 volt and each division .01 volt. The purpose for the center zero scale is to indicate a balanced condition. For example, if this instrument is used in the alignment of an FM discriminator, the desired balanced condition will result in a reading of zero on the meter. A misaligned condition will cause some deflection in either the positive or negative direction.

4. MEASURING AC VOLTAGES (RMS & P-P):

NOTE

Effect of waveform in measuring AC voltages: This instrument employs a peak-to-peak type detector, and is calibrated using a sinusoidal signal. The scale is calibrated to give RMS readings, using effective values based on a true sinewave. When it is known that other than sinusoidal signals are being used, it must be recognized that the accuracy as specified for sinusoidal waveforms will not apply. However, peak-to-peak values will remain accurate using the peak-to-peak scales on the meter.

a. Set the FUNCTION switch to the AC V position.

b. Set the PROBE switch to DIRECT.

c. Set the RANGE switch to the desired position. If the voltage is not known, set RANGE switch fully clockwise.

d. Short test leads together and rotate ZERO control until meter pointer rests over zero mark on VOLTS/MA scale.

e. Connect the black (negative) lead of the test lead assembly to the chassis or reference point of the circuit under test.

f. Bring the tip of the probe in contact with the point in the circuit where the voltage is to be measured.

g. Observe the meter indication. RMS voltage is read on the two red scales just below the mirrored scale on the meter. To measure peak-to-peak voltage, the two red scales marked VOLTS P-P are used. The scale readings are multiplied by the same multiplier factors as were used in DC voltage measurements.

5. dB MEASUREMENTS:

The dB scale (−10dB to +6dB) for measuring output level is calibrated according to the standard of 1mW into 600 ohms and direct scale readings apply with the RANGE switch in the 1.5V position (0dBm). The ten AC V ranges are in 10dB steps, so that starting from "0dB" on the 1.5V range, add 10dB for each range above 1.5 volts and subtract 10dB for each range below 1.5 volts. All dB measurements are a measure of the ratio between the voltage in the circuit under test and the standard reference level indicated above. If the impedance across which the measurement is taken is other than 600 ohms, use Figure 2 to determine actual power level with respect to 600 ohm reference. The chart in Figure 3 can be used to determine the power being dissipated in a circuit if the circuit impedance along with either the applied voltage, or the dB is known. This chart also shows the relationship of AC volts to dB.

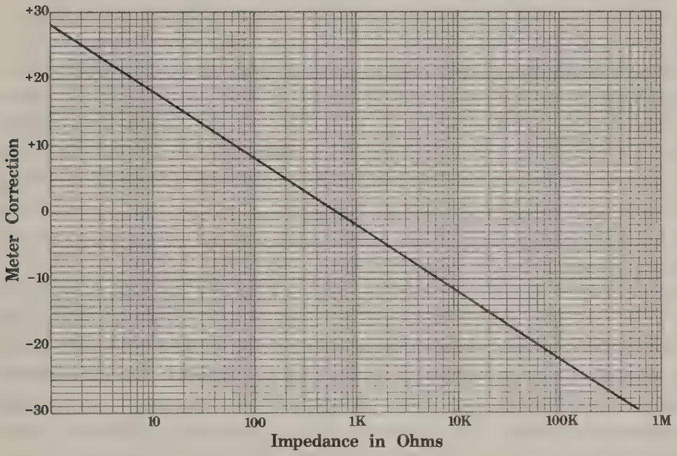


Figure 2. DB Correction Chart

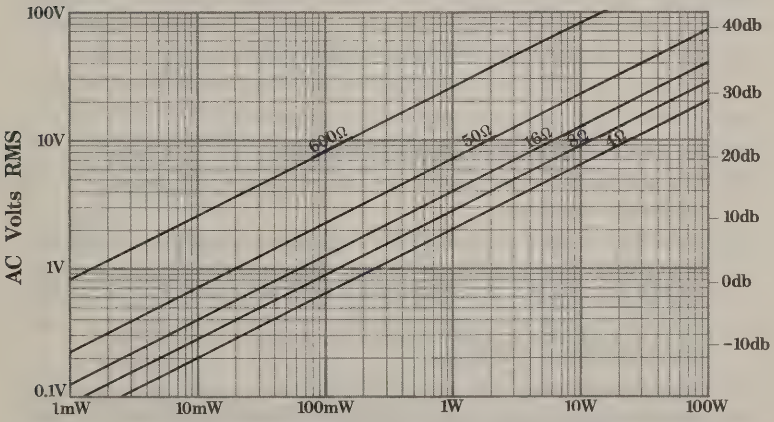


Figure 3. Voltage vs. Power Chart (Sine Wave Conditions Only)

NOTE

The dB scales of this meter and the charts in Figure 2 and Figure 3 only apply when the voltage being measured is a pure sine wave. Complex waveforms such as those encountered in music material will not give a true RMS reading for the dB system to be accurate, however, the dB scales can be used for relative level measurements.

6. MEASURING RESISTANCES:

CAUTION

When making resistance measurements be sure that the power to the equipment under test is disconnected. If voltage is accidentally applied to the ohms ranges, fuse replacement may become necessary.

a. **Hi Ohms Measurements.** To measure resistance, set the FUNCTION switch to the HI OHMS position, and the RANGE switch to the range that will put the resistance to be measured as close to the center of meter scale as possible. When the FUNCTION switch is placed in the OHMS functions, the meter pointer will move from the left hand edge of the meter (zero) to the infinity (∞) mark on the right hand side of the meter. Short test leads together and rotate ZERO control until meter pointer rests over zero mark on ohms scale. Remove short from test leads and rotate the OHMS control to adjust the meter pointer to exactly the infinity (∞) mark on the right hand side of the meter. Be sure that the probe switch is in the DIRECT position. When using the HI OHMS function in solid state circuits, the applied 1.25 volts will be high enough to cause diodes or transistors to conduct. On all resistance ranges, the probe tip is positive with respect to the minus (–) test lead. Remember this when checking components which have a different forward and reverse resistance such as semiconductors and electrolytic capacitors.

b. **Checking for Triggering of Low-Power Silicon-Controlled Rectifiers (SCR):** Low-power SCR's can be checked to see if they can be triggered to the ON condition. To make this check, proceed as follows:

(1) Set the FUNCTION switch to HI OHMS and the RANGE switch to RX1.

(2) Adjust OHMS control so meter reads full scale (∞).

(3) Set the PROBE switch to the DIRECT position.

(4) Connect Minus (–) test lead to the cathode of the SCR and the Plus (+) test lead to the anode.

(5) If the SCR is good, the meter will continue to read ∞. Now momentarily short the SCR gate lead to anode lead. The meter should read a very low resistance, indicating that the SCR has been triggered and is conducting. Removing voltage from the anode lead of the SCR will return it to the non-conducting condition.

c. **Lo Ohms Measurements.** The LO OHMS function is used to make resistance measurements in solid state circuits when the forward conduction of a diode or transistor junction can cause an objectionable error. When using this function, only 33 millivolts (.033 volt) is applied to the circuit being measured (42 millivolts on RX0.1 Range). This is well below the conduction threshold of silicon and germanium semiconductor junctions. The resistances measured with this instrument in the LO OHMS function will only be the resistance of the circuit components connected to the transistor or diode, and will not be affected by the semiconductor device.

NOTE

> The following checks can be made on IC's using the HI-LO OHMS functions of this instrument:
>
> The resistor values within the IC can be measured using the LO power ohms function to determine if the resistor values have changed due to overloads. Transistors and diodes within the IC can be checked for leakage using the LO power ohms function and a high resistance range such as RX1 meg. Substrate leakage of an IC can be checked by using a high resistance range such as RX1 meg and the HI power ohms function. Front-to-back ratio of transistors and diodes can be measured by using the HI power ohms function and reversing the test leads.

NOTE

> If the transistor or diode within the IC is shunted by resistances, the highest of the two readings taken (by reversing the test leads) is the equivalent resistance value of the resistors within the IC.

Many other measurements can be made if a schematic diagram of the IC is used.

d. **Very Low Resistance Measurements:** Very low resistance measurements without damage to semiconductors or components can be made using the RX0.1 LO OHMS range. Only 42 millivolts is applied to any device under test on this range. Uses for this resistance range are many. Some typical applications are listed below:

Resistance wire measurements.
Coil windings.
Transformer windings.
Wirewound resistors.
Switch contact resistance.
Cold resistance of lamps.
Fuses.
Heavy wire measurements.

To make resistance measurements on this range proceed as follows:

NOTE

> Do not use test leads for making resistance measurements on this range, as an error in readings will result.

(1) Set the FUNCTION switch to LO OHMS.

(2) Set the RANGE switch to RX0.1.

(3) Connect a short heavy gauge wire between the plus and minus jacks and adjust ZERO control until pointer rests exactly over zero mark on OHMS scale.

(4) Remove short from test jacks. The meter pointer will move from the left hand edge of the meter (Zero) toward the infinity (∞) mark on the right hand side of the meter. Rotate the OHMS control to adjust the meter pointer to exactly the infinity mark.

(5) Repeat ZERO and OHMS adjustments at least one more time to obtain the best accuracy.

(6) Make solid connections between test jacks and device being measured and read resistance on OHMS scale (if device has no leads, use short heavy gauge wire).

(7) Multiply resistance reading by 0.1. For example, if the meter reads 10 ohms (center scale) the resistance being measured will be 10 x 0.1 = 1 ohm.

NOTE

It will be necessary to readjust the OHMS and ZERO controls when returning to the higher Ohms ranges.

e. **Measuring Resistance of Thermistors:** The LO OHMS function should be used for making accurate measurements of resistances of thermistors of low resistance value. If this measurement is made in the HI OHMS function, a changing resistance reading will result due to heating caused by the higher current flow through the thermistor. The thermistor should not be held in the hand and should be kept away from any other heat to obtain the most accurate resistance indication.

7. MEASURING AC CURRENT:

a. Set the FUNCTION switch to the AC A position.

b. Set the PROBE switch to DIRECT.

c. Short test leads together and rotate ZERO control until meter pointer rests over zero mark on VOLTS/MA scale.

d. Set RANGE switch to the desired range. If the approximate value of current flowing within the circuit is not known, set the RANGE switch to the 1.5A position and work down toward the 50μA range until an accurate reading is obtained.

e. Turn the power to the equipment under test OFF and open the circuit in which you wish to measure current flow. Connect the ground lead of the test lead assembly to one side of the circuit. Connect the tip of the probe to the other side of the circuit under test.

f. Turn the power to the equipment under test ON and observe the meter pointer deflection. Set the RANGE switch to obtain the most accurate indication (nearest to full scale). AC current is read on the two red scales just below the mirror scale on the meter.

8. MEASURING DC CURRENT:
   a. Set the FUNCTION switch to DC A.
   b. Set the PROBE switch to DIRECT position
   c. Short test leads together and rotate ZERO control until pointer rests over zero mark on VOLTS/MA scale.
   d. Set the RANGE switch to the range desired. If the approximate value of current flowing within the circuit is not known, turn the RANGE switch to the 1.5A position and work down toward the 50μA range until an accurate reading is obtained.
   e. Open the circuit in which you wish to measure current flow. Make sure that meter is inserted in series with the load in which the current is being measured. Do not connect the meter in parallel with the voltage source connected to the load. A severe current overload will blow the fuse. Connect the ground lead of the test lead assembly to the negative side of the circuit. Connect the tip of the probe to the positive side of the circuit under test.
   f. Turn the power on in the circuit under test. Observe the meter pointer deflection. If the pointer is deflected to the left the current polarity is opposite of that which was anticipated. Reverse the test leads and the meter will read up scale. DC current is read on the two black scales just above the mirror scale on the meter.

9. MEASURING DC CURRENTS BELOW 50μA: Reverse leakage current of transistors or diodes can be measured accurately with this instrument at the specified reverse voltage for the device. To make this measurement connect a 100,000 ohms, 5% or better precision resistor across the instrument input terminals. Connect diode or transistor in series with the positive (+) lead and an external power supply voltage. Connect negative (–) lead to minus on power supply.

NOTE

Diode or transistor must be connected in the reverse direction to make a reverse leakage measurement.

Set the FUNCTION switch to +DC V position and the RANGE switch to 1.5V/MA. Increase voltage from the external supply to that specified for the device to be tested. Read leakage current on the two black scales just above the mirrored scale on the meter. Full scale indications are as follows:

Range Switch Position	Full Scale DC Current
1.5V/mA	15μA
500mV/mA	5μA
150mV/mA	1.5μA
50mV/mA	.5μA

NOTE

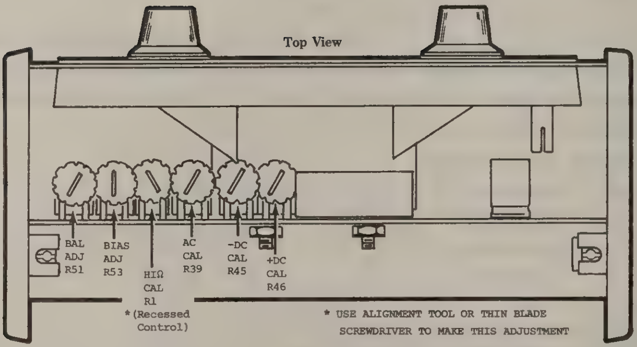
When measuring current higher than 1.25 Amps, limit measurement time to less than 5 minutes, or fuse replacement may become necessary.

CALIBRATION AND MAINTENANCE

The calibration, bias and balance adjustments have been carefully and accurately adjusted at the factory, and they should not require readjustment unless components have been replaced or these adjustments have been disturbed. If, for any reason, recalibration becomes necessary, carefully perform the following procedures as required.

CALIBRATION OF THE 290 (SEE FIGURE 4 FOR ADJUSTMENT LOCATIONS): To gain access to the calibration adjustments it will be necessary to remove the back from this instrument. To remove the back cover, remove the two (2) screws located at the bottom rear and the two (2) screws at the rear near the top of the cover. After the screws have been removed, tilt the bottom part of the back cover outward (away from rear of unit) allowing the line cord to slide through opening and then gently lift the back cover up and away from the top portion of the front panel. Adjustments must be made in the order indicated below:

BIAS ADJUSTMENT: Connect an external voltmeter between + meter terminal and common ground (foil ground, common jack, etc.). Set the ZERO control so meter pointer rests over zero mark on VOLTS/MA scale. Adjust Bias adjustment (R53) so that external meter reads 6.5 volts.



* USE ALIGNMENT TOOL OR THIN BLADE SCREWDRIVER TO MAKE THIS ADJUSTMENT

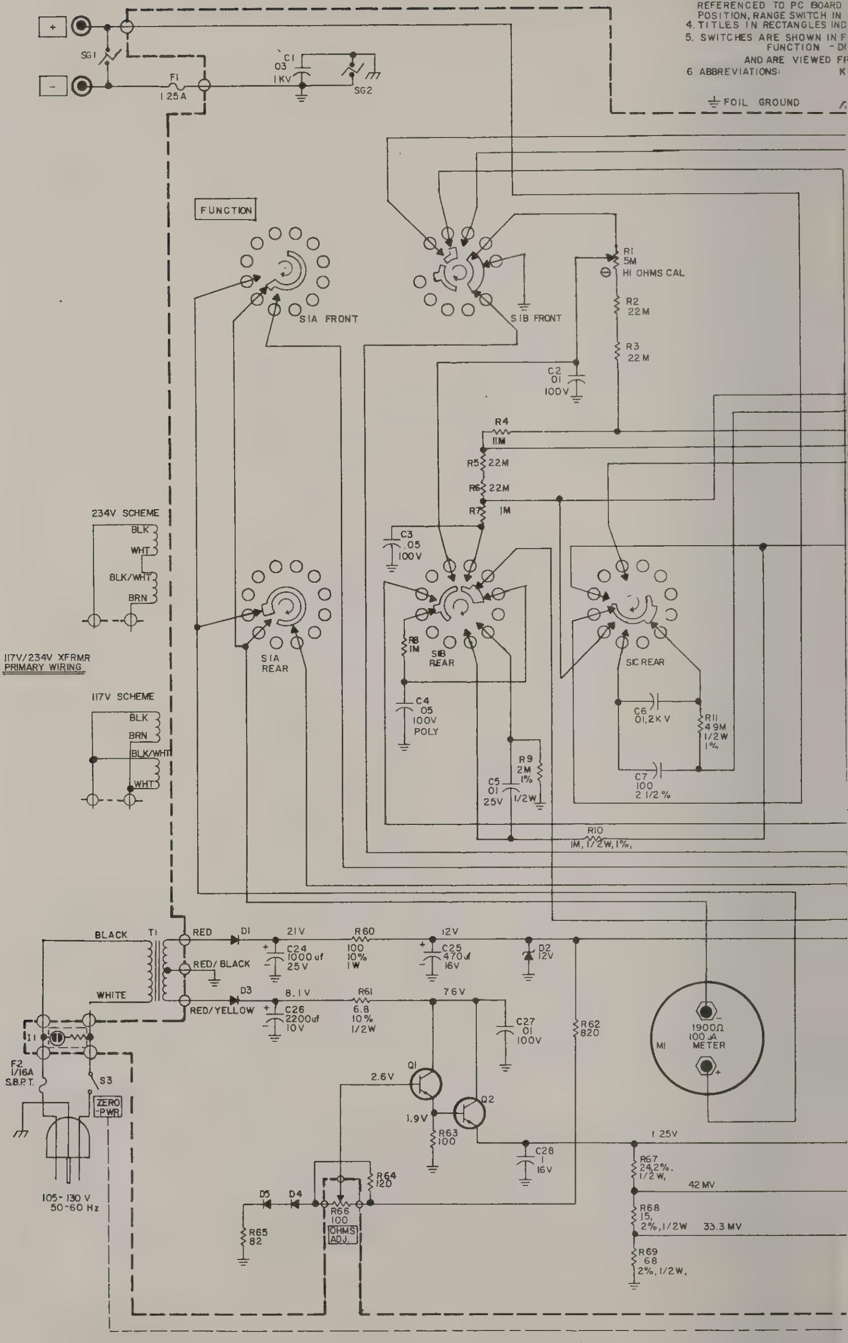
Figure 4. Adjustment Locations

B & K PRECISION MODEL 290 PARTS LIST

488-133-9-002 B

SCHEMATIC SYMBOL	DESCRIPTION	B & K PART No.
	RESISTORS	
R9	2M, ½W, 1% P.F Deposited Carbon Resistor	002-026-9-001
R10, R18	1M, ½W, 1% P.F. Metal Film Resistor	011-061-9-001
R11	4.9M, ½W, 1% P.F. Deposited Carbon Resistor	002-001-9-029
R13	9.4Ω, ½W, 1% P.F. Metal Film Resistor	011-063-9-001
R14, R26	100Ω, ½W, 2% P.F. Metal Film Resistor	011-067-9-001
R15	1K, ½W, 2% P.F. Metal Film Resistor	011-066-9-001
R16	10K, ½W, 2% P.F. Metal Film Resistor	011-020-9-001
R17	100K, ½W, 1% P.F. Metal Film Resistor	011-059-9-001
R19	.025Ω, ½W, 1%, 1.5A Shunt	004-135-9-001
R20	.09Ω, ½W, 1%, 500mA Shunt	004-117-9-001
R21	.305Ω, ½W, 1% P.F. Wirewound Resistor	004-112-9-001
R22	.95Ω, ½W, 1% P.F. Wirewound Resistor.	004-105-9-001
R23	3.16Ω, ½W, 1% P.F. Wirewound Resistor	004-136-9-001
R24	10Ω, ½W, 1% P.F. Metal Film Resistor	011-043-9-001
R25	31.6Ω, ½W, 1% P.F. Deposited Carbon Resistor	002-016-9-001
R27	316Ω, ½W, 1% P.F. Deposited Carbon Resistor	002-017-9-001
R28	684Ω, ½W, 1% P.F. Metal Film Resistor	011-058-9-001
R29	2.16K, ½W, ½% P.F. Metal Film Resistor	011-049-9-001
R30	6.84K, ½W, ½% P.F. Metal Film Resistor	011-050-9-001
R31	21.6K, ½W, ½% P.F. Metal Film Resistor	011-051-9-001
R32	68.4K, ½W, ½% P.F. Metal Film Resistor	011-052-9-001
R33	216K, ½W, ½% P.F. Metal Film Resistor	011-053-9-001
R34	684K, ½W, ½% P.F. Metal Film Resistor	011-054-9-001
R35	2.16M, ½W, ½% P.F. Deposited Carbon Resistor	002-020-9-001
R36	6.84M, 1W, ½% Deposited Carbon Resistor	002-019-9-001
R67	24Ω, ½W, 2% P.F. Metal Film Resistor	011-065-9-001
R68	.15Ω, ½W, 2% P.F. Wirewound Resistor	004-127-9-001
R69	.68Ω, ½W, 2% P.F. Wirewound Resistor	004-126-9-001
	POTENTIOMETERS	
R1	5 meg Trim Pot (HI Ω Cal)	008-161-9-001
R39	50K Trim Pot (AC Cal)	008-093-9-001
R45	20K Trim Pot (–DCV Cal)	008-139-9-001
R46	500K Trim Pot (+DCV Cal)	008-129-9-001
R51	1K Trim Pot (Balance Adj)	008-068-9-001
R53	100 Trim Pot (Bias Adj)	008-131-9-001
R66	100Ω Carbon Pot (Ohms Adj)	008-195-9-001
R71	15K Carbon Pot (Zero Control)	008-139-9-001
	CAPACITORS	
C1	.03μfd, 1000V, +80 –20 Ceramic Disc Capacitor	020-093-9-001
C6	.01μfd, 2000V, +80 –20 Ceramic Disc Capacitor	020-113-9-001
C7	100pfd, 500V, 2% P.F. Silver Mica Capacitor	030-034-9-001
C9	.1μfd, 200V, 5% P.F. Mylar Capacitor	025-075-9-001
C10	.05μfd, 200V, 5% P.F. Mylar Capacitor	025-064-9-001
C11	.015μfd, 250V, 5% P.F. Mylar Capacitor	025-037-9-001
C12	.0047μfd, 250V, 5% P.F. Mylar Capacitor	025-034-9-001
C13	.0015μfd, 600V, 5% P.F. Mylar Capacitor	025-035-9-001

NOTES
1 ALL RESISTOR VALUES ARE IN
2.CAPACITORS MARKED IN DECI
NUMBER VALUES ARE IN pf.
3 VOLTAGE MEASUREMENTS T
REFERENCED TO PC BOARD
POSITION, RANGE SWITCH IN
4. TITLES IN RECTANGLES IND
5. SWITCHES ARE SHOWN IN F
FUNCTION - D
AND ARE VIEWED FR
6 ABBREVIATIONS: K



1/4 W, 5 %, UNLESS OTHERWISE SPECIFIED.
LUES ARE IN uf. CAPACITORS MARKED IN WHOLE

VITH A HIGH IMPEDANCE VOLTMETER AND
ROUND WITH FUNCTION SWITCH IN +DC V
POSITION AND NO SIGNAL INPUT.
FRONT PANEL NOMENCLATURE.
UNTER CLOCKWISE POSITION,
NGE 50 mV,
RONT PANEL.

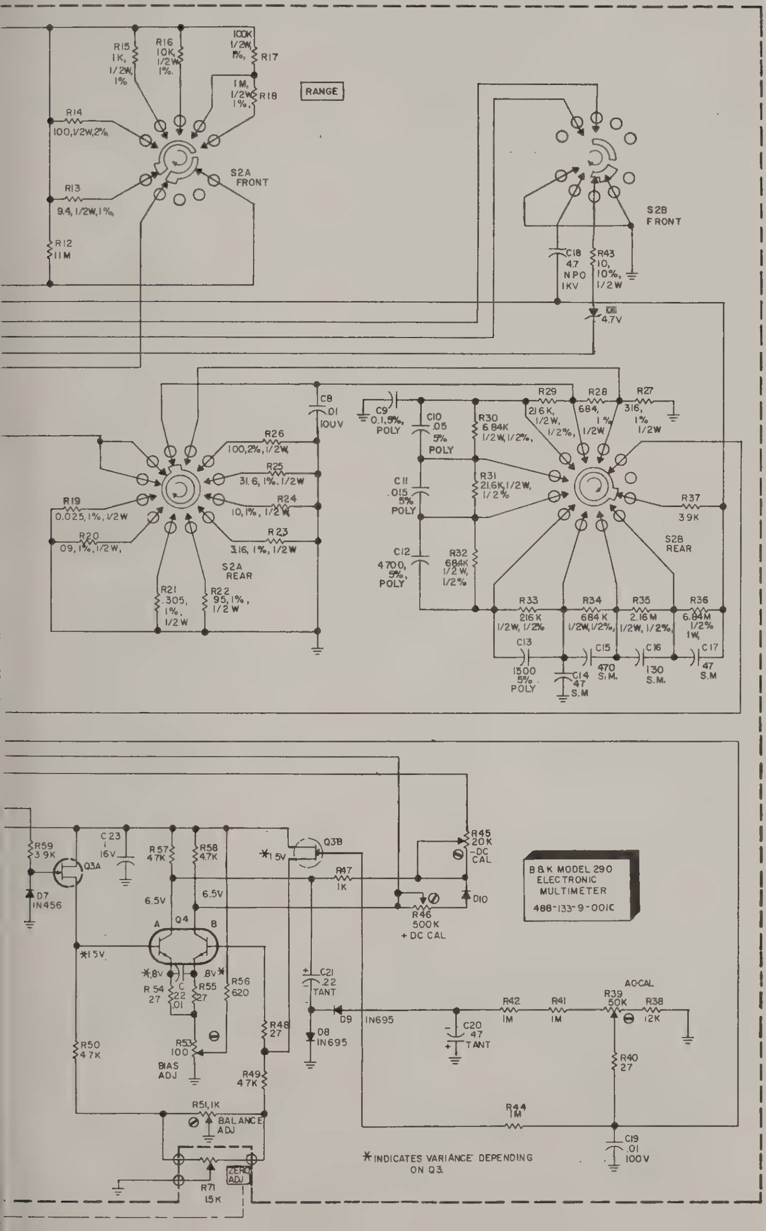
M=1,000,000

TANT. - TANTALUM, 35V

E GROUND

POSITION	FUNCTION	RANGE S2
1	-DC V	50mV, 50μA, 140mV p-p, R x 0.1
2	+DC V	150mV, 150μ A, 420mV p-p, R x 1
3	AC V	500mV, 500uA, 1400mV p-p, R x 10
4	HI OHMS	1.5V., 1.5mA, 42 Vp-p, R x 100
5	LO OHMS	5V, 5mA, 14Vp-p, R x 1K
6	ACA	15V, 15mA, 42Vp-p, R x 10K
7	DCA	50V, 50mA, 140Vp-p, R x 100K
8	———	150 V, 150mA, 420 Vp-p, R x 1M
9	———	500V, 500mA, 1400 Vp-p
10	———	1500 V, 1500mA, 4200 Vp-p.

SCHEMATIC SUBJECT TO CHANGE WITHOUT NOTIFICATION.



B&K MODEL 290
ELECTRONIC
MULTIMETER
488-133-9-001C

*INDICATES VARIANCE DEPENDING ON Q3.

LAST NUMBER USED	NOT USED
R71	R 52
C28	
D10	
Q4	
T1	
M1	
F2	
SG2	
S3	
I1	

CAPACITORS (Cont.)

SCHEMATIC SYMBOL	DESCRIPTION	B & K PART No.
C14, C17	47pfd, 500V, 5% P.F. Silver Mica Capacitor	023-044-9-001
C15	470pfd, 500V, 5% P.F. Silver Mica Capacitor	023-042-9-001
C16	130pfd, 500V, 5% P.F. Silver Mica Capacitor	023-041-9-001
C18	4.7pfd, ±.25pfd, 1KV, NPO P.F. Disc Capacitor	031-036-9-001
C20	.47μfd, 25V, 20% P.F. Tantalum Capacitor	027-006-9-001
C21	.22μfd, 25V, 20% P.F. Tantalum Capacitor	027-004-9-001
C24	1000μfd, 25V, Electrolytic Capacitor	022-107-9-001
C25	470μfd, 16V Electrolytic Capacitor	022-100-9-001
C26	2200μfd, Electrolytic Capacitor	022-108-9-001

DIODES & TRANSISTORS

D1, D3, D4, D5	Diode, Silicon, 1 Amp, 600 PIV	151-018-9-001
D2	Diode, Zener, 12V, 1W 5%	152-039-9-001
D6	Diode, Zener, 4.7V, 1W, 10%	152-052-9-001
D7	Diode, Silicon, 1N456	151-037-9-001
D8, D9	Diode, Germanium, 1N695	150-007-9-001
D10	Diode Silicon IN4148	151-038-9-001
Q1	Transistor Silicon Signal, NPN	176-023-9-001
Q2	Transistor, Silicon Low Power, NPN	176-008-9-001
Q3	FET, Dual N Channel	182-024-9-001
Q4	Transistor Signal, Dual NPN	176-041-9-001

SWITCHES

S1	Rotary Switch (Function)	083-140-9-001
S2	Rotary Switch (Range)	083-141-9-001
S3	Switch, ON-OFF	Part of R52

MISCELLANEOUS

F1	Fuse, 3AG, 1.25 Amp	191-004-9-001
F2	Fuse, Pigtail, 3AG, 1/16 Amp S.B.	193-004-9-001
T1	Transformer, Power, 117 Volts	065-074-9-003
	115 /230 Volts	065-074-9-002
	Direct/100K Probe	PR-21
	Instruction Manual	480-143-9-001
	Case, End Panel, Left	271-014-9-001
	Case, End Panel Right	271-015-9-001
	Handle	746-025-9-001
	Handle Stud	763-018-9-001
	Handle Friction Washer	731-013-9-001
	Handle Retaining "E" Ring	741-049-9-001
	Meter, 100μA, 1900Ω	320-046-9-001
	Meter Washer, Spring	731-028-9-001
	Knob, (Zero & Ohms)	751-064-9-001
	Knob, (Function & Range)	751-104-9-001
	Front Panel, for 320-046-9-001 meter	255-101-9-903
SG-1	Spark Gap, 2KV	033-014-9-001
SG-2	Spark Gap, 1.5KV	033-012-9-001

NOTE: Standard value resistors and capacitors are not listed, values may be obtained from schematic diagram.

Minimum charge $2.00 per invoice. Orders will be shipped C.O.D. unless previous open account arrangements have been made or remittance accompanies order. Advance remittance must cover postage or express charge.

SPECIFY SERIAL # WHEN ORDERING REPLACEMENT PARTS.

BALANCE: The balance adjustment must be set to obtain the following results:

1. Slowest movement of meter pointer through zero (at left end of meter scale) when ZERO control is rotated.
2. An indication of .3 or higher on the 0 to .5 volt scale with ZERO control set fully clockwise.

To adjust the Balance adjustment, set the RANGE switch to the 1500 volt range, the FUNCTION switch to +DC V and the Balance adjustment to ½ rotation. Rotate ZERO control to ½ rotation and readjust Balance adjustment until meter reads zero. Rotate ZERO control fully clockwise. Meter pointer must indicate .3 or higher on 0 to .5 volt/mA scale. Readjust ZERO control for zero and closely observe movement of pointer through zero at left end of meter scale. If pointer movement appears to be too rapid, adjust Balance adjustment to obtain slowest movement of pointer through zero.

–DC VOLTS CALIBRATION: First check the setting of the mechanical and electrical zero adjustments. Set the RANGE switch to the 500mV range, and the FUNCTION switch to the –DC V position. Set the Probe switch to the 100K position. Apply exactly –0.5 volt DC to the input terminals and adjust –DC Cal Pot (R45) for exactly a .5 indication on the 0 to .5 VOLTS/MA scale.

+DC VOLTS CALIBRATION: Set FUNCTION switch to the +DC V position. Apply exactly 0.5 volts DC to the input terminals and adjust +DC Cal Pot (R46) for exactly .5 indication on the 0 to .5 VOLTS/MA scale.

AC VOLTS CALIBRATION: First check the setting of the mechanical and electrical zero adjustments. Set the RANGE switch to the 50mV position, and the FUNCTION switch to the AC V position. Set the Probe switch to the DIRECT position. Short the test leads together and zero meter. Apply exactly a 0.5 volt RMS sine wave (60Hz) to the input terminals and adjust AC Cal Pot (R39) for a .5 indication on the meter 0 to .5 VOLTS/MA scale.

NOTE

Calibration accuracy is dependent on accuracy of the calibrating source.

HI OHMS CALIBRATION: Set the FUNCTION switch to the LO OHMS position and the RANGE switch to the RX100 position. Set the Probe switch to DIRECT. Short test leads together and adjust ZERO control for exactly zero at left hand side of meter scale. Open test leads and adjust OHMS control to exactly infinity (∞) at right hand side of meter ohms scale. Set FUNCTION switch to HI OHMS and without touching Ohms control adjust HI OHMS Cal (R1) so that meter reads exactly infinity (∞).

REMOVING THE INSTRUMENT FROM ITS CASE: To gain access to the printed circuit board and for general servicing, the case (end pieces) must be removed from the front panel.

To remove the case, first remove the cover (see instructions under "Calibration and Maintenance"). Next, remove the two screws from the tie bar located at the top rear, just above the meter. Rotate the handle down toward the bottom rear of the instrument. Gently pull end pieces outward (sideways) and away from front panel. Lift end pieces up and away from front panel.

To remove the printed circuit board from the front panel, proceed as follows:

1. Remove the two (2) screws at the bottom rear of the unit that holds the transformer bracket in place.
2. Remove the two (2) large control knobs and control nuts on the front panel.
3. Slide the top portion of the meter back (away from front panel).
4. Remove the two (2) large meter retaining nuts located at approximately the center of the P.C. Board.
5. Remove the meter from the front of the P.C. board. Sufficient lead length is provided to allow servicing of the P.C. board components.

OVERLOAD PROTECTION: This instrument is protected against accidental overloads on all functions and all ranges. The voltage ranges are protected because the high input impedance limits the amount of voltage and current applied to the gate of the FET. On the resistance and current functions, the fuse F1 and diode D1 protect both the meter movement and the circuitry. This fuse should be replaced with one of the same type so that the protection feature and accuracy of this instrument are not affected. Accuracy of the RX0.1 range will be most affected by using an incorrect fuse type.

CIRCUIT DESCRIPTION

The Model 290 Electronic Multimeter uses a balanced bridge impedance converter consisting of a dual field effect transistor and a dual bi-polar transistor. This circuitry provides high input impedance and excellent stability.

When making DC voltage measurements the DC voltage is applied thru R11 to the voltage divider (R36 through R27). The RANGE switch S2B selects the required input voltage to be applied to the input gate of Q3A. The FET Q3A provides the necessary high input impedance, and drives the base of Q4A.

Q4 operates as a stable differential amplifier with the meter connected between the collectors. The base of Q4A is driven by Q3A for DC volts, ohms, and for DC current measurements. The base of Q4B (the 2nd half of the differential pair) is driven by Q3B for AC voltage and current measurements. This half of Q3B is in turn driven by the peak-to-peak detector, D8 and D9. In the DC volts, ohms and DC current functions, the peak-to-peak detector does not receive a signal from Q3A because of an AC rejection filter (R8, C4).

The dual FET and dual transistor are independent of temperature effects because they are small T0-71 and T0-78 packages and very little temperature differential can exist between sections.

In the resistance measurement function, a standard resistor is placed in series with either a 33mV or 1.25 volt source and the voltage is applied to the gate of Q3A. The meter will read up scale with this arrangement and the OHMS control allows adjustment at exactly full scale (∞). If the test leads are shorted together, the gate of Q3A will be shorted to ground and therefore receive no voltage. The meter then reads zero ohms. If a resistor between zero ohms and infinity resistance is placed between the test leads, the gate will receive a voltage proportional to the resistor ratios (internal standard and measured resistor) and the meter will indicate the resistance on the OHMS scale. If the resistance being measured is equal to the standard internal resistance of this instrument exactly one half of the voltage will be applied to the gate and the meter will read half scale. Voltages for both OHMS functions are obtained from a well regulated and filtered power supply.

The 33 millivolts for the LO OHMS function is developed across a voltage divider R67, R68, and R69, and applied directly to the gate of Q2A thru a standard resistor. With more IC's and transistors being used everyday the LO OHMS function of this instrument is a must for making resistance measurements in solid state circuits.

When making AC measurements the AC rejection filter is switched out and AC is applied to the same divider as is used for DC voltage measurements. However, capacitors across the divider now provide frequency compensation on all ranges. Therefore, all frequencies between approximately 30Hz and 250KHz are attenuated equally in this divider when switching ranges. The differential amplifier provides AC gain and the peak-to-peak detector develops a negative voltage dependent on the peak positive and the negative voltage swing of the input voltage fed to it. The gate of Q3B receives the detected signal, applies it to Q4B which in turn drives the meter. Any DC voltage which would normally be applied to the gate of Q4B is shorted out in the AC volts functions by the switch.

When measuring current, a standard resistor is selected by the RANGE switch and put in series with the circuit to be measured. The voltage (AC or DC) developed across the standard resistor is then measured and read as current on the meter. The fuse F1 protects low value resistors which are more susceptible to burnout. Fuse protection is not required on high resistance value resistors. The meter movement itself is protected on all ranges because it is isolated thru the impedance converter.

WARRANTY SERVICE INSTRUCTIONS

1. Refer to the maintenance section of the instruction manual for adjustments that may be applicable.
2. Defective parts removed from units which are within the warranty period should be sent to the factory, prepaid, with model and serial number of product from which removed, and date of product purchase.
3. If the above mentioned procedures do not correct the difficulty, pack the product securely (preferably double packed). A detailed list of troubles encountered must be enclosed as well as your name and address. Forward prepaid (express preferred) to the nearest B & K authorized service agency.

Contact your local B & K Distributor for the name and location of your nearest service agency, or write to:

Service Department
B & K DIVISION OF DYNASCAN CORPORATION
2815 W. Irving Park Rd.
Chicago, Illinois 60613

WARRANTY

"B & K warrants that each product manufactured by it will be free from defects in material and workmanship under normal usage and service for a period of ninety days after its purchase new from an authorized B & K distributor. Our obligation under this warranty is limited to repairing, or replacing any product or component which we are satisfied does not conform with the foregoing warranty and which is returned to our factory or our authorized service contractor, transportation prepaid, and we shall not otherwise be liable for any damages, consequential or otherwise. *The foregoing warranty is exclusive and in lieu of all other warranties (including any warranty of merchantability), whether expressed or implied.* Such warranty shall not apply to any product or component (i) repaired or altered by anyone other than B & K or its authorized service contractor (except normal tube replacement) without B & K's prior written approval; (ii) tampered with or altered in any way or subjected to misuse, negligence or accident; (iii) which has the serial number altered, defaced or removed; or (iv) which has been improperly connected, installed or adjusted otherwise than in accordance with B & K's instructions. B & K reserves the right to discontinue any model at any time or change specifications or design without notice and without incurring any obligation. *The warranty shall be void and there shall be no warranty of any product or component if a B & K warranty registration card is not properly completed and postmarked to the B & K factory within five days after the purchase of the product new from an authorized B & K distributor.*"

B&K

DYNASCAN CORPORATION
1801 West Belle Plaine Avenue, Chicago, Illinois 60613

480-143-9-001

GND
SKOKIE, ILLINOIS

INSTRUCTION
MANUAL

B+K PRECISION 1248

DIGITAL IC
COLOR GENERATOR

B+K PRECISION
Product of DYNASCAN CORPORATION
6460 West Cortland Street, Chicago, Illinois 60635

Dear Friend:

Congratulations on your purchase of B & K-Precision Test Equipment, and welcome to the B & K-Precision family. We hope your experience with your new test equipment will make you a lifetime B & K-Precision customer.

Your instrument is backed by more than 20 years of experience in designing and manufacturing. Our most important goal is your satisfaction. At B & K-Precision, test equipment is made to meet the demands of the field, focusing on dependability and accuracy. We also concentrate on simplicity and operating ease with features that reduce the possibility of human error and speed the servicing process.

In order to determine the type of test units that are needed we have been guided by letters and reports from technicians and engineers who use the equipment daily. Our field tests and studies have helped provide better and faster service techniques.

B & K-Precision product designs are constantly reviewed, and refinements are made or new models developed to meet advances in our industry and to fill your needs. We set our standards high so you can be assured that B & K-Precision test instruments you buy represent advanced design, quality construction, and dependable long-term performance at a price you can afford.

If you have any comments or thoughts about our products, or test equipment in general, I would be delighted to hear from you.

Thanks for your confidence in B & K-Precision and we look forward to serving you for a long time to come.

Sincerely,

Carl Korn

Carl Korn
President

model 1248
S/N 23-12135
pur. 2-6-80

INSTRUCTION MANUAL

FOR

Model 1248

DIGITAL IC COLOR GENERATOR

B+K PRECISION
DYNASCAN CORPORATION
6460 West Cortland Street
Chicago, Illinois 60635

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WARRANTY . . . . Cov. 3

INTRODUCTION

The Model 1248 Digital IC Color Generator incorporates the latest advances in digital circuit technology. The custom MOS integrated circuit contains all the circuitry necessary for producing broadcast-quality video signals.

Nine patterns are programmed into the 1248 to provide for complete and easy convergence of color receivers. Two crystal-controlled, keyed rainbow color displays are provided to test color circuits, range of hue control and to align color demodulators. A front panel COLOR LEVEL control permits displaying color saturation to any degree up to 150% of sync amplitude.

Multiple dot and crosshatch patterns are provided for adjusting horizontal and vertical linearity, centering, and size on color or black and white TV receivers. Dot size and vertical line width are sharp and bright. Preset to an optimum at the factory, they can be easily readjusted to suit personal preference.

Two crystal-controlled RF channels and a crystal-controlled IF output allow signal injection at the tuner or into the IF section of a receiver.

A 4.5 MHz tuning aid is provided for easy set-up of the receiver fine tuning.

The 1248 also provides a video output signal for injection into a television receiver beyond the video detector and for evaluation of video recorders. Positive-or negative-going sync of at least 1.5V P-P into 75 ohms is provided.

An oscilloscope trigger output is also provided for easy viewing of horizontal or vertical signals.

A zener-regulated power supply provides constant, ripple-free voltage to all internal circuitry even under abnormal line conditions.

SPECIFICATIONS

PATTERNS

Purity	Clear raster
Dots	Single dot at center screen 7 x 11
Lines	Single vertical at center Single horizontal at center
Crosshatch	1 x 1, crosshair 7 x 11
Color Bars	R-Y, B-Y, –(R-Y): 3 bars gated at 90°, 180°, and 270° from burst. Gated Rainbow: 10 bars gated at 30° intervals from burst.

LINE WIDTH

Horizontal	1 horizontal scan line
Vertical	Preset to .25μSEC; internally adjustable from .1 to .8μSEC.

CHROMA

Offset subcarrier system utilizing a frequency of 3.579545 MHz minus 1 horizontal line (15734 Hz) or 3.563811 MHz ± .002%. 10 bars and R-Y, B-Y, –(R-Y) are produced by gating with 188.8 kHz and 63 kHz respectively. The chroma level is front panel adjustable from 0 to 150%.

SIGNAL SYNTHESIS

The 1248 uses a progressive scan system processed by a custom MOS integrated circuit which generates all sync and video information from a 377.6 kHz master crystal oscillator.

SYNC PULSES

	Horizontal	Vertical
Period	63.559μSEC (15734 Hz)	16.652mSEC (60.05 Hz)
Width	5.0847μSEC	190.677μSEC

BLANKING PULSES

	Front Porch	Rear Porch	Total
Horizontal	1.2712μSEC	5.0847μSEC	11.441μSEC
Vertical	223.73μSEC	983.9μSEC	1.398mSEC

RF OUTPUT		
Channels	Crystal-controlled on CH. 3 (61.25 MHz) and CH. 4 (67.25 MHz). Selectable by front panel pushbuttons.	
Levels	10,000 microvolts minimum into a 300Ω Load.	
IF OUTPUT		
Frequency	45.75 MHz, switch-selected, crystal-controlled	
Level	10,000 microvolts, minimum into 75Ω	
VIDEO OUTPUT	0 to ±1.5V P-P, continuously variable into 75Ω	
SYNC OUTPUT	5 V horizontal or vertical, switch-selectable	
TUNING AID	4.5 MHz unmodulated carrier, ± .2% Fixed injection level of 30% of total modulation.	
POWER REQUIREMENTS	100 to 130 Volts AC, 60 Hz	
OPERATING RANGE	From –25°C to 75°C	
MECHANICAL	Size	2.25" x 7" x 9.375"
	Weight	3 lbs.
	Cable Storage	24.75 cubic inches

OPERATING PROCEDURE

A. CONTROLS AND FUNCTIONS

1. COLOR LEVEL: Rotation of this control adjusts the color sub-carrier amplitude from 0 to 150%; at midpoint (indicator vertical) the level is normal or 100% of sync amplitude. In the extreme counterclockwise position, AC power to the unit is switched off.

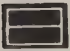
2. PATTERN SELECTOR: Nine patterns are programmed into the 1248. In sequence:

Purity. Provides sync and reference black for a clear blemish-free raster.

Single Center Dot. Defines center screen and is useful for static convergence.

7 x 11 Dot Pattern. Used in static or dynamic convergence. Dot width is preset to .25 μSEC but may be readjusted internally to suit personal preference.

Single Vertical Line at Center Screen. Used for converging vertical lines.



Single Horizontal Line at Center Screen. Used for converging horizontal lines.

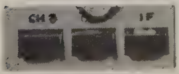
Crosshair. The intersection of the two lines corresponds to center screen and is useful for adjusting position as well as convergence.

7 x 11 Crosshatch. Extremely useful in dynamic convergence, linearity, size and overscan adjustments. The sharp definition of the horizontal and vertical lines helps to insure precise convergence.

R-Y, B-Y, –(R-Y). Derived from the rainbow pattern and gated at 90°, 180°, and 270°, respectively, to rapidly expedite color alignment procedures.

Gated Rainbow. 10 color bars raised on a 50% luminance pedestal and gated at 30° intervals from burst; they are used for testing and aligning color circuitry. The reference black background gives sharp edge definition and aids in recognizing color spill.

3. CARRIER SELECTION: The 1248 offers operation at three crystal-controlled carrier frequencies. Channel 3 (61.25 MHz), Channel 4 (67.25 MHz) or IF (45.75 MHz) can be selected by simply depressing the desired front panel pushbutton.



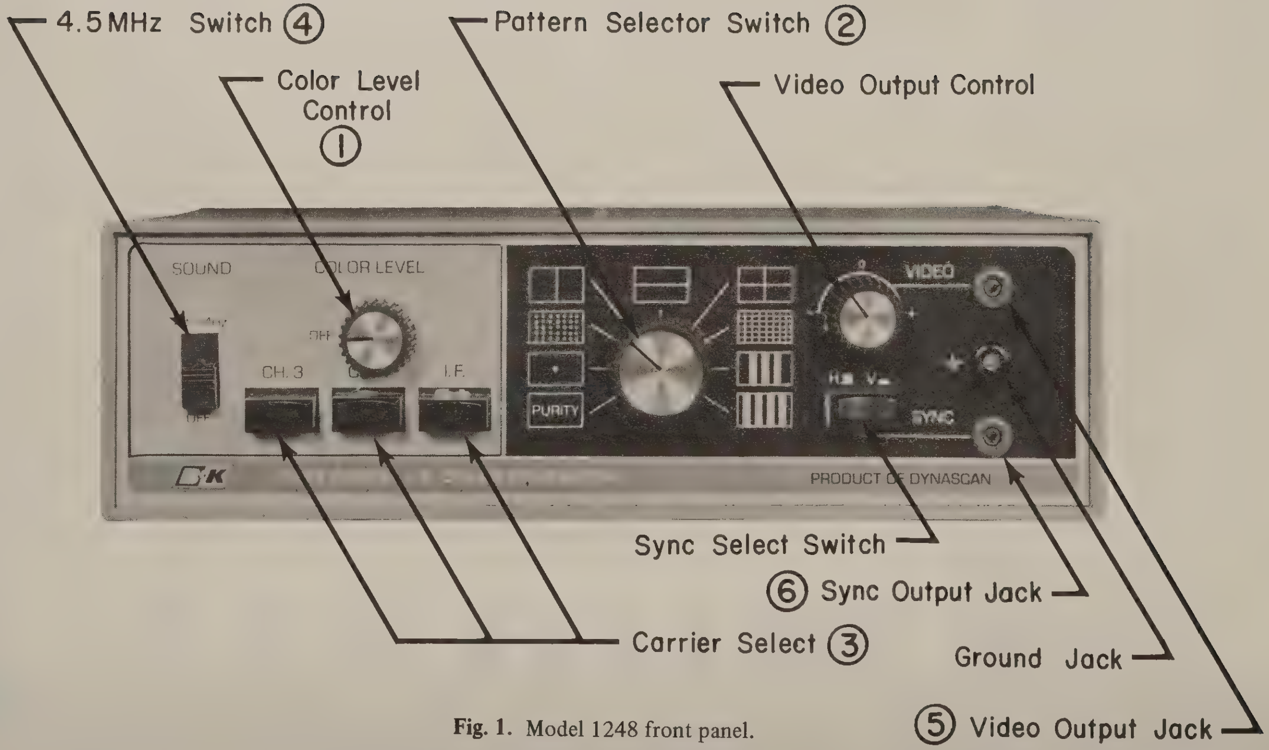
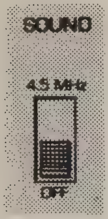
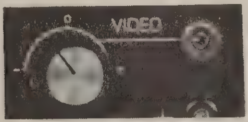


Fig. 1. Model 1248 front panel.

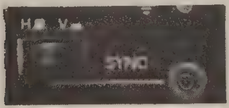
4. TUNING AID: The 4.5 MHz switch energizes an oscillator which inserts a 4.5 MHz subcarrier into the composite video and blanks the bars in the two color positions to provide an ungated rainbow. A 936 kHz "herringbone" pattern (4.5 MHz–3.56 MHz) will appear on the screen to aid in accurately fine-tuning the receiver.



5. VIDEO OUTPUT: The 1248 provides a video output for signal substitution directly into the video circuits of a television receiver and for testing video recorders. Clockwise rotation of the video output control will produce a composite video signal with positive-going sync. Counterclockwise rotation produces negative-going sync. A minimum of 1.5V of signal is produced into 75Ω.



6. SYNC OUTPUT: The 1248 also provides a sync output jack for use in synchronizing an oscilloscope for viewing the composite video waveform. When the pushbutton is "out", horizontal sync pulses are present at the output jack. Pushing the button "in" provides vertical sync pulses.



B. OPERATION

NOTE

Read this entire section carefully to avoid unnecessary confusion and to obtain maximum performance from the 1248.

1. Disconnect all antenna lines from the receiver VHF antenna terminals; attach the 1248 RF cable to these terminals.
2. Tune both the receiver and generator to either channel 3 or 4.
3. Turn the instrument on by rotating the COLOR LEVEL control clockwise.
4. Rotate the pattern selector to GATED RAINBOW and set the COLOR LEVEL control to its midpoint position (indicator vertical); advance the receiver color level control approximately 1/4 from minimum. Adjust the contrast and brightness to provide a comfortable viewing intensity.
5. Slide the 4.5 MHz switch to the ON position. All bars will disappear.
6. Rotate the receiver fine tuning until an ungated rainbow with a light herringbone pattern appears; this is due to a beat between the sound and color subcarriers. Adjust the fine tuning once again for color with minimum herringbone. At this point, the receiver IF sound trap has attenuated the 4.5 MHz, and the receiver is properly tuned. Switch off the 4.5 MHz.

NOTE

With certain receivers, it may be impossible to either locate or tune out the herringbone. This may be due to a poorly aligned sound trap. An alternate method of fine tuning is presented if this occurs.

ALTERNATE METHOD OF FINE TUNING:

1. Set the pattern selector to CROSSHATCH, switch off the 4.5 MHz and fine tune the receiver until a reasonably good display is obtained.
2. Reduce the contrast and brightness controls until both the horizontal and vertical lines are barely visible; one may be brighter than the other, but both should be *visible.*
3. Carefully readjust the fine tuning for brightest vertical lines, then reset the contrast and brightness for a comfortable viewing intensity.

NOTE

The 1248 possesses a high percentage of RF modulation. To obtain the sharpest test pattern and avoid "blooming" of the TV screen display, never operate the receiver with excessive contrast and brightness during convergence or color adjustments.

4. Rotate the pattern selector to GATED RAINBOW and set the COLOR LEVEL control to its midpoint position.
5. Advance the receiver color level control until color appears. When color does not appear at all or only with the control near maximum, carefully readjust the fine tuning. It should only require a slight amount of rotation; *excessive* rotation indicates tuner or IF misalignment. If this last step fails to produce color, it is likely that a malfunction exists somewhere in the receiver and must be corrected before proceeding. When the receiver is properly tuned, it is then ready for convergence and color adjustments.

C. VIDEO OUTPUT

Signal substitution can be carried out beyond the video detector using the video output signal provided by the 1248. Both positive and negative polarity signals are controlled by the VIDEO control. Clockwise rotation provides a signal with positive-going sync and CCW rotation provides negative-going sync. The peak-to-peak amplitude varies with control rotation.

Connect a test lead from the GND (black) jack on the 1248 to the receiver chassis. Connect another lead from the Video (red) jack on the 1248 to the receiver test location. (A pair of pin plugs are provided for test lead hook-up.) Set the VIDEO control to the proper polarity and amplitude.

Adjust the following receiver controls for a clear display: color, tint, brightness, and contrast.

A minimum of 1.5V P-P signal into 75Ω is available from the 1248. A $20\mu F$ DC blocking capacitor is built into the video output circuit of the 1248. The video output should not be connected to a location where more than ±200V is present.

D. OSCILLOSCOPE TRIGGERING

When it is desirable to view the video signals from the receiver on an oscilloscope the sync signals for triggering the scope are available from the 1248. This feature minimizes the readjustments required when viewing the video signal at the horizontal or vertical rate.

Connect a lead from the black GND jack on the 1248 to the receiver chassis. Connect another lead from the red SYNC jack on the 1248 to the oscilloscope EXT TRIGGER input. Set the trigger or sync control on the scope for external trigger and the polarity + (positive).

The trigger signal applied to the scope is determined by the SYNC selector switch. With the button "out", horizontal sync pulses are applied; when "in", vertical sync pulses are applied.

Once the oscilloscope controls are set, no further adjustments are necessary when viewing horizontal or vertical signals.

CONVERGENCE

A detailed convergence procedure will not be presented here, as there are many excellent and thorough manuals available on this subject; however, the principle pattern uses are presented to help speed convergence.

A. PURITY

The first position of the 1248 selector provides sync and a reference baseline free of video information. This is advantageous when adjusting purity. Older methods required turning to an unused channel or disabling the tuner; "snow" produced by this method can be annoying and cause inaccuracy in set-up. Using this position, the operator can be assured that the adjusted purity condition will be maintained when the convergence procedure is initiated.

B. STATIC CONVERGENCE

Static, or DC, convergence is always performed *before* and *after* purity adjustments. The 1248 pattern switch is programmed to provide the necessary dot patterns in the positions following purity. The single center dot pattern is most convenient because it automatically pinpoints screen center and is quickly located when working from behind the receiver, viewing the screen at an angle.

C. DYNAMIC CONVERGENCE

Crosshatch is the recommended pattern for performing dynamic convergence, although some technicians use dots throughout the entire procedure; this is a matter of personal performance. However, misconvergence is most easily seen with horizontal and vertical lines.

The single horizontal line and the single vertical line patterns are useful when converging red and green lines at these locations. Elimination of all other lines removes any confusion as to the correct points to converge.

NOTE

Defocusing, blooming and "kinks" at crosshatch intersections indicate that brightness and contrast are excessive. It is important never to perform convergence in this condition, or accuracy will greatly suffer.

COLOR ADJUSTMENTS

Service notes should always be consulted when testing and aligning color circuitry. Following the recommended procedure will assure best performance. The following sections provide a general technique if manufacturer's data is not available.

A. HUE SETTING AND RANGE

Step 1. Rotate the 1248 pattern selector to GATED RAINBOW and set the COLOR LEVEL control to its mid-point position.

Step 2. Adjust the receiver's saturation, brightness and contrast controls to produce a pleasing color pattern. Ten individual color bars should be visible on the face of the screen (see Fig. 2 and 4).

NOTE

Some receivers may only display eight or nine bars; this is due to excessive overscan and/or blanking.

Step 3. Turn the 1248 selector to R-Y, B-Y, –(R-Y). Three color bars, representing the third, sixth and ninth bar out of the gated rainbow should now be visible.

Step 4. Adjust the receiver's HUE control to display a red, blue, and bluish green bar in this order from left to right (see Fig. 3). If this arrangement cannot be obtained with any setting of the HUE control, then internal adjustment of hue range coil or control is necessary.

It can be assumed that the color circuits in the receiver are operating properly if these steps produce the correct results.

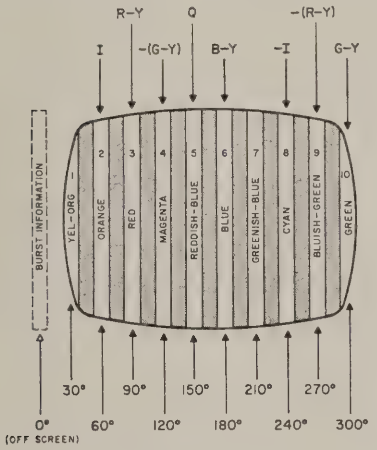


Fig. 2. Gated rainbow.

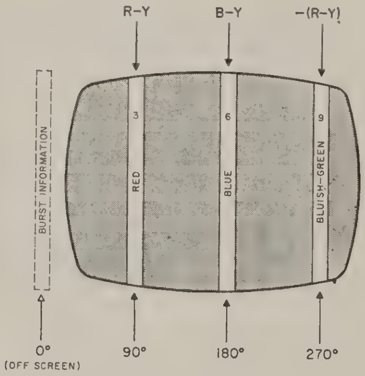


Fig. 3. R-Y, B-Y, –(R-Y).

B. DEMODULATOR ALIGNMENT CHECK

A rapid check of demodulator alignment can be performed without the use of a vectorscope right in the customer's home. This technique is simple and utilizes the color CRT itself as the analysis instrument.

Step 1. Rotate the 1248 selector to R-Y, B-Y, –(R-Y) and set the COLOR LEVEL control to its mid-point position.

Step 2. Turn the receiver's contrast control to minimum and adjust the brightness for the brightest display possible without blooming; the receiver color control should be set to a very low level-just enough to produce color.

Step 3. Disable the red and green guns of the CRT. Adjust the HUE control so that color and shading in the area to the left and right of the first bar (left hand side of screen) matches the center section of that bar.

Step 4. Disable the blue and green guns and leave only the red gun active. If the color demodulators are properly aligned, the bar in the center of the screen will match the color and shading of the area to either side of it. A large amount of error usually indicates the need for demodulator alignment.

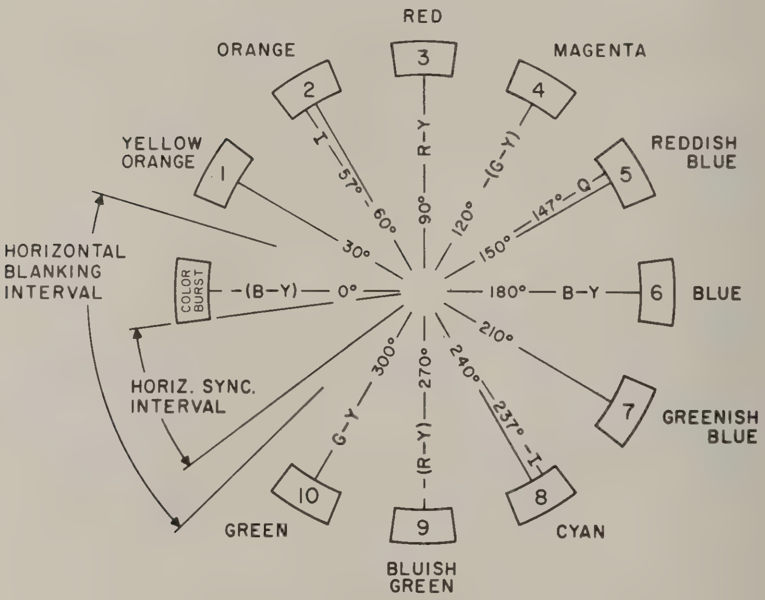


Fig. 4. Gated rainbow phase relation.

C. COLOR SYNC LOCKING

The COLOR LEVEL control on the 1248 varies the amplitude of the color subcarrier from 0 to 150%. Utilization of this control can help determine if the set will adequately lock on a color signal.

Step 1. Rotate the 1248 selector to GATED RAINBOW and adjust the COLOR LEVEL control to its mid-point position; this represents normal color subcarrier amplitude.

Step 2. Adjust the receiver color control to produce a recognizable color pattern.

Step 3. Slowly rotate the 1248 COLOR LEVEL control counterclockwise until the colors become pale and finally disappear; the rate of fading will depend entirely upon the model under test. Most receivers will maintain color sync throughout the entire range of the level control; however, some sets may lose it just before the color disappears, evidenced by their diagonal running. Both of these conditions indicate normal operation of the sync circuits. If a slight reduction of the chroma amplitude from normal causes the color to fall out of lock, synchronization of the receiver may be inadequate.

In the full clockwise position of the COLOR LEVEL control, the amplitude of the sub-carrier is 150% of sync amplitude. This additional range is helpful in diagnosing receiver conditions, such as RF/IF misalignment or chroma circuit malfunction.

D. COLOR FIT

The 1248 produces color bars that are raised on a luminance pedestal so that spaces between the colors are reference black. When displaying 10 and 3 bar patterns, color should only be seen in the luminance area; a defective delay line in the video amplifier or incorrect alignment of the chroma bandpass amplifier will cause the colors to overlap or spill into the black region.

E. COLOR KILLER

Color killer threshold can be set while displaying CROSSHATCH; adjust the color killer control of the receiver until the vertical lines start to tear with color. Back this control off until the tear is removed, then give a slight additional turn to provide a safety margin.

DEFLECTION SYSTEM TESTS

A rapid check of receiver scanning can help disclose any abnormal or border-line situations which might exist in the electrical or mechanical components of the deflection system. When evaluating any results from these tests, always use the manufacturer's recommendations as a criterion.

A. OVERSCAN

1. Rotate the 1248 pattern selector to CROSSHATCH.
2. Adjust receiver contrast and brightness to display sharp, thin lines against a black background.
3. Count the number of vertical and horizontal lines. A typical receiver will display 10 vertical and 7 horizontal lines. An additional vertical line, however, may just be visible at the screen's edge; this one is outside the normal picture area and should be ignored when performing adjustments.

NOTE

Certain receivers have an inherent tendency towards a greater amount of overscan and/or blanking. This phenomenon may result in a 9 x 7 crosshatch instead of a 10 x 7. The same effect will produce an 8 x 9 color bar pattern instead of 10.

B. LINEARITY, SIZE AND CENTERING

The repetitive spacing of the CROSSHATCH pattern provides a stable source with which to perform these tests and adjustments. Abnormal conditions such as pincushion distortion, deflection non-linearity and excessive 60 Hz hum become immediately obvious.

Vertical size and linearity should be adjusted so that all horizontal lines are evenly spaced. Inability to do so usually indicates a vertical deflection problem.

Pincushion distortion is common to a great number of large screen receivers; the outermost vertical and horizontal crosshatch lines are most useful in determining the correct amount of compensation.

A horizontal bar rolling vertically through the crosshatch pattern indicates that 60 Hz hum is entering the receiver circuitry. Excessive amounts of it cause a very noticeable and annoying pattern displacement.

The CROSSHAIR pattern provides 1 vertical and 1 horizontal line that intersect at exact screen center; any visual deviation from it may indicate a need for position adjustments.

THEORY OF OPERATION

The heart of the model 1248 Digital IC Color Bar Generator is the custom MOS digital integrated circuit. This 16-pin package contains all the digital countdown circuitry, gating logic, and D/A converters necessary to produce a composite video signal with a minimum of external components. See Fig. 5.

Pins 12 and 13 of the IC are the input pins to the on-chip oscillator circuit. A 377.6 kHz crystal is connected to these terminals to establish the master oscillator at this frequency. C3, C4, and R4 are added to stabilize the oscillator frequency. Pins 3, 4, 5, and 6 are internally connected to a decoder ROM (Read Only Memory) which selects the proper video pattern (crosshatch, dots, etc.) from the BCD information provided to these pins by the PATTERN SELECTOR switch.

Vertical line width is determined by an RC timing network which is connected to pins 7 and 8. Varying the resistance of R3 increases or decreases the width of vertical lines and dots. The vertical lines present at .25μSEC and may be adjusted from .1 to .8μSEC to suit personal preference.

The composite video output appears at pin 9 and the color bar gating signal appears at pin 10. Sync signals appear at pin 1 with horizontal or vertical being selected by a high or low at pin 16.

Transistor Q2 adds the color bar gating signal to the sync signal and also provides a luminous step for the color bars. Q2 also provides positive and negative video signals which are buffered by Q3 and are available at the video output on the front panel.

Transistor Q4 is a modified Crystal-Colpitts oscillator with R22 (COLOR LEVEL) as the load resistor; the output is thus variable in amplitude from 0 to 150% of sync level. Q5 is operated as a switch which grounds the color signal between bars. The gating signal comes from pin 10 of IC1 and is buffered by Q1 which drives the base of Q5.

Transistor Q6 and surrounding components comprise a temperature-compensated 4.5 MHz oscillator which generates the sound subcarrier used as a tuning aid. Capacitor C22 injects a level of 30% total modulation excursion into the modulator. A front panel slide switch controls power to this circuit and also blanks the bar patterns to provide an ungated rainbow.

The assembled composite video from Q2 is sent to the VHF OSCILLATOR/MODULATOR where it is impressed upon the desired RF frequency and routed through the output cable. Q7 and surrounding components form a crystal-controlled VHF oscillator that generates the carrier frequency. Front panel pushbuttons control the DC bias to six RF switching diodes thereby energizing the desired crystal and selecting the proper resonating capacitor for the tank circuit. Modulator transistor Q8 is a low-capacity device connected as a diode; this scheme provides temperature compensation and a high modulation percentage. Shielded coaxial cable is provided for convenient connection to the receiver terminals.

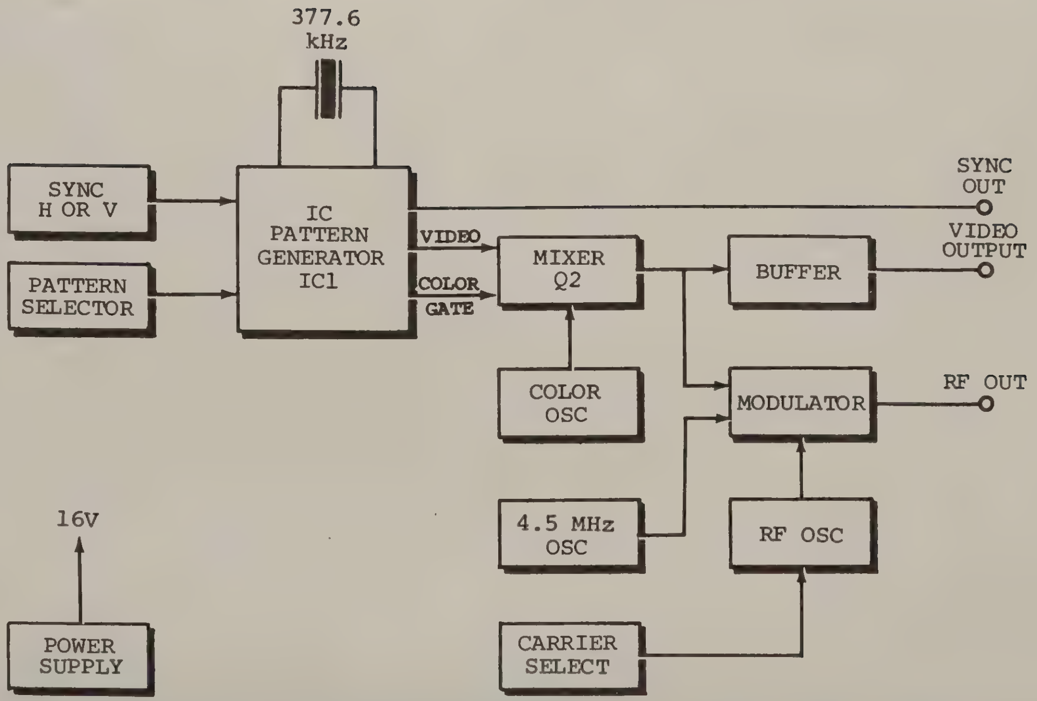


Fig. 5. Block diagram.

CALIBRATION AND MAINTENANCE

The 1248 is aligned and calibrated at the factory for optimum performance. As a result, access to the instrument's interior is only necessary for dot size readjustment—all other trimming controls should not be touched. If misalignment occurs either through damage or accidental movement, recalibration is possible by following the procedures in succeeding sections.

A. DOT SIZE

Trimmer control R3 DOT SIZE (See Fig. 6) varies the width of pulses used to construct dots and vertical lines. It is preset to .25μSEC, which has been found to produce a sharp, bright dot on the majority of receivers. If readjustment is preferred, simply display a dot pattern and rotate this control until the desired size is obtained. Since vertical lines are also affected, it is wise to inspect the crosshatch pattern; a compromise between optimum dot size and vertical line width may be necessary.

B. RF OSCILLATOR/MODULATOR

Because the RF carrier of the 1248 is crystal-controlled, it is not necessary to retune L2 when changing channels; it has purposely been damped so that Q7 will oscillate with either of the crystals. If operation on one channel should cease, rotate L2's slug to see if it can be restored before suspecting component failure.

It is necessary to view the detector output of a working receiver with an oscilloscope when calibrating the MOD trimmer, R15.

1. Set-up the receiver and generator to display CROSSHATCH.
2. Adjust the oscilloscope to view two vertical fields of the recovered waveform.
3. Rotate R15 until the sync amplitude (upper half) of the composite signal equals the video amplitude (lower half).

C. COLOR OSCILLATOR

A frequency counter with input impedance of greater than 100kΩ is needed to perform the following adjustments:

1. Rotate the 1248 selector to GATED RAINBOW and turn the unit on.
2. Attach the frequency counter across the COLOR LEVEL control and rotate the COLOR LEVEL control fully clockwise.
3. Adjust "COLOR TRIM" capacitor (C11) with a non-metallic tool until a reading of 3.563811 MHz in obtained.

D. 4.5 MHz OSCILLATOR

1. Attach the frequency counter to the emitter of Q6 (see Fig. 6).
2. Slide the actuator of the 4.5 MHz front panel switch to ON and adjust L1, 4.5 ADJ, for a reading of 4.500 MHz. Calibration is now complete.

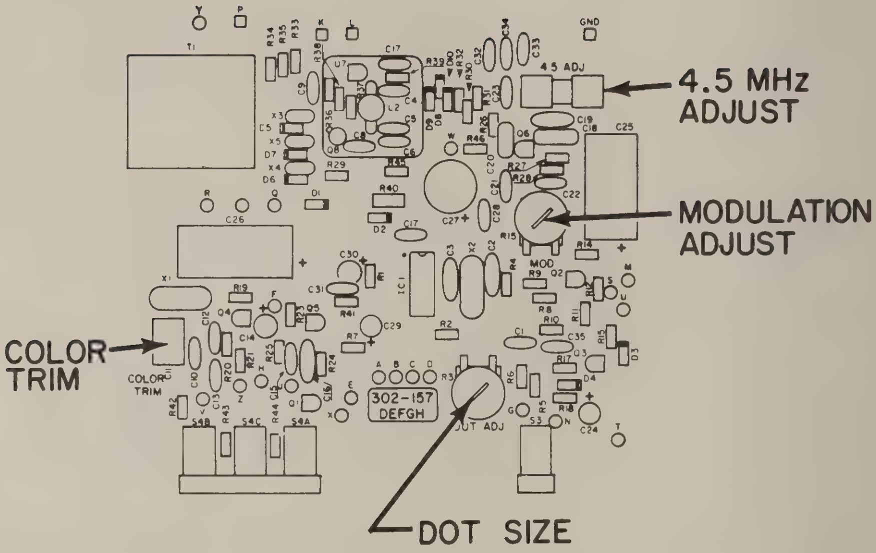


Fig. 6. Location of internal adjustments.

SCHEMATIC SYMBOL	DESCRIPTION	B & K PART NO.

SWITCHES

S1	9-Position Rotary, Function	083-167-9-001
S2	DPDT Slide, "4.5MHz"	084-017-9-001
S3	Pushbutton, "SYNC"	088-024-9-001
S4	3-Station, Pushbutton	088-025-9-001

MISCELLANEOUS

	Cable, RF	539-029-0-000
	Case, Leather, Carrying	271-026-9-001
	Foot, Rubber	381-004-9-001
	Instruction Manual	480-158-9-001
	Jack, Tip, Black	773-055-9-001
	Jack, Tip, Red	773-056-9-001
	Knob, Control	751-069-9-001
	Knob, Rotary Switch	751-114-9-001
	Knob, Pushbutton	384-018-9-001

NOTE: Standard value resistors and capacitators are not listed. Values may be obtained from schematic diagram. Minimum charge $5.00 per invoice. Orders will be shipped C.O.D. unless previous open account arrangements have been made or remittance accompanies order. Advance remittance must cover postage or express charges. Specify serial number when ordering replacement parts.

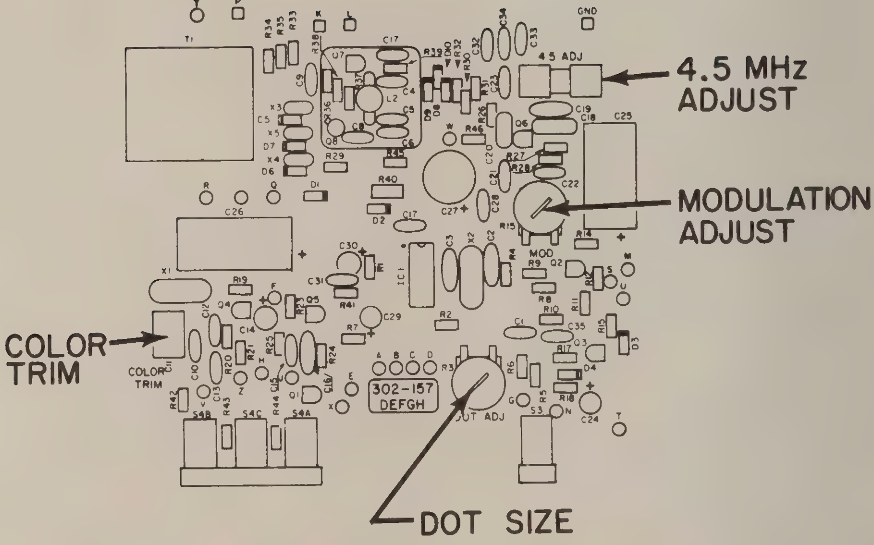
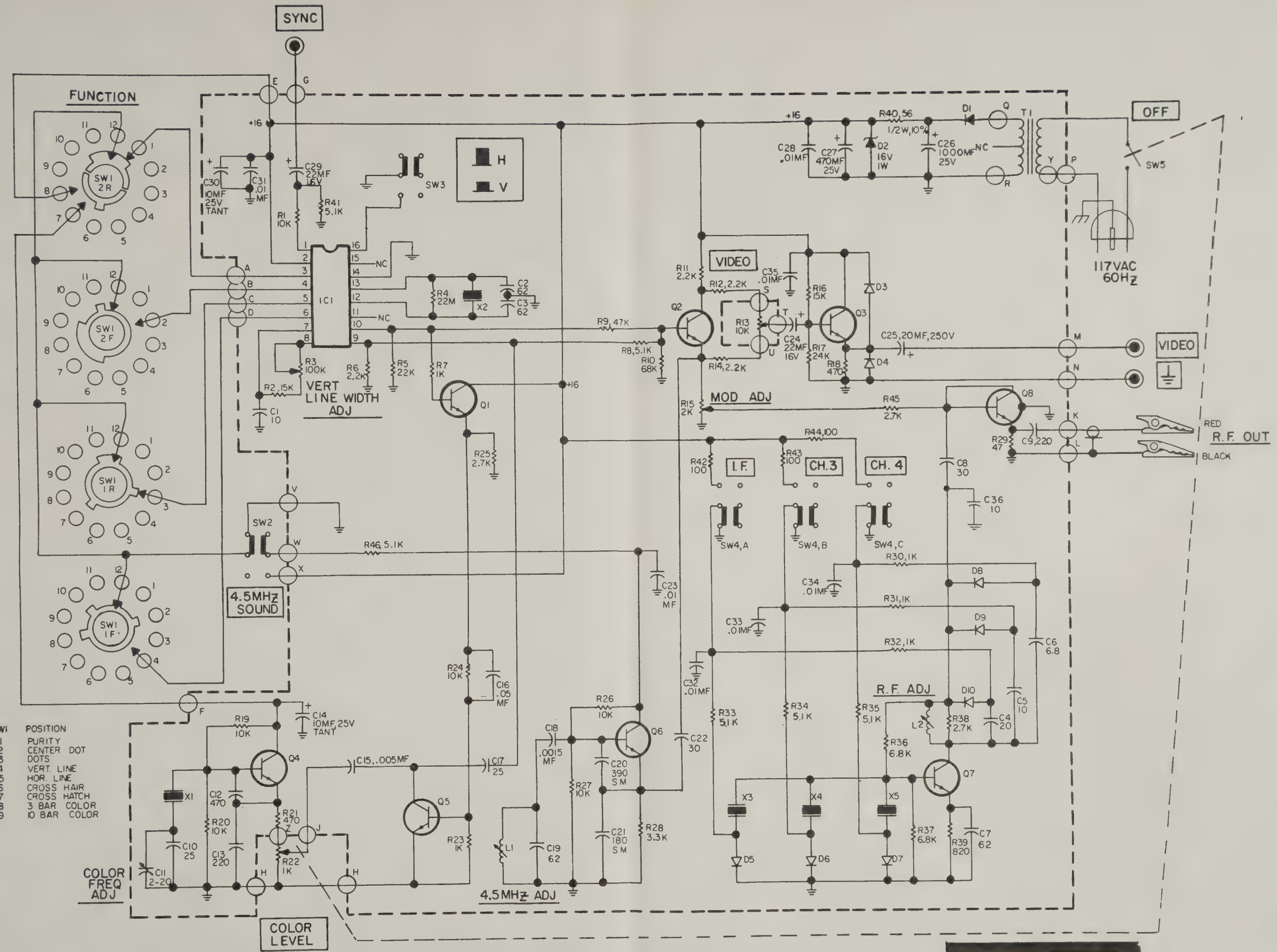


Fig. 6. Location of internal adjustments.



SW1	POSITION
1	PURITY
2	CENTER DOT
3	DOTS
4	VERT. LINE
5	HOR. LINE
6	CROSS HAIR
7	CROSS HATCH
8	3 BAR COLOR
9	10 BAR COLOR

LAST NO.'S USED
R46
C36
D10
Q8

UNLESS OTHERWISE SPECIFIED:
1. ALL RESISTANCE IN OHMS 1/4W, 5%
2. ALL CAPACITORS IN P.F.
3. SW1 SHOWN IN FULL CCW POSITION (PURITY)
SW2, SW4, SW5 SHOWN IN OFF POSITION (SW3 SHOWN IN HOR. POSITION, OUT)
4. TITLES IN RECTANGLES INDICATE FRONT PANEL NOMENCLATURE
5. ABBREVIATIONS:
K=1,000
M=1,000,000
TANT = TANTALUM
⏚ = FOIL GROUND
⏊ = CASE GROUND

B&K
MODEL 1248
DIGITAL I.C. COLOR GENERATOR
488-142-9-001 B

B&K-PRECISION MODEL 1248 PARTS LIST

488-142-9-002 C

SCHEMATIC SYMBOL	DESCRIPTION	B & K PART NO.
	RESISTORS & POTENTIOMETERS	
R3	100k, ±30%, 1/8W, Trimpot	008-216-9-001
R13	10k, ±30%, 1/4W, Carbon Pot, VIDEO	008-215-9-001
R15	2k, ±30%, 1/8W, Trimpot	008-217-9-001
R22/S5	1k, ±30%, 1/4W, Carbon Pot/Switch, COLOR LEVEL	008-214-9-001
	CAPACITORS	
C11	2-20pf, Trimmer	028-001-9-001
C14, C30	10 MF, 25V Tantalum	027-006-9-002
C18	.0015 MF, ±5%, Mylar	025-035-9-001
C19	90 PF, N750, ±5%, Ceramic Disc	020-079-9-001
C20	390 PF, ±5%, Silver Mica	023-004-9-001
C21	180 PF, ±5%, Silver Mica	023-025-9-001
C24, C29	22 MF, 16V, Electrolytic	022-085-9-001
C25	20 MF, 250V, Electrolytic	021-034-9-001
C26	1000 MF, 25V, Electrolytic	022-107-9-001
C27	470 MF, 25V, Electrolytic	022-095-9-001
	COILS & TRANSFORMERS	
L1	4.5 MHz Coil	044-023-9-001
L2	RF Oscillator Coil	044-017-9-001
T1	Power Transformer	065-063-9-001
	CRYSTALS	
X1	3.563795 MHz	131-003-9-001
X2	377.6 kHz	131-018-9-001
X3	45.75 MHz	132-002-9-009
X4	61.25 MHz	132-004-9-002
X5	67.25 MHz	132-004-9-004
	DIODES, TRANSISTORS & IC'S	
D1,D3,D4	1A Silicon Diode	151-050-9-001
D2	16V, ±5%, 1W, Zener Diode	152-009-9-001
D5-D10	1N4148 Silicon Diode	151-038-9-001
Q1-Q6	MPS A20, NPN, Silicon Transistor	176-023-9-001
Q7	SE1010, NPN, Silicon Transistor	176-005-9-001
Q8	40897, NPN, Silicon Transistor	176-040-9-001
IC1	MM5322, Custom MOS Integrated Circuit	307-057-9-001

COMPOSITE
499-070-9-001 C

WARRANTY SERVICE INSTRUCTIONS

1. Refer to the MAINTENANCE section of your B & K-Precision instruction manual for adjustments that may be applicable.

2. Defective parts removed from units which are within the One Year Limited Warranty period should be sent PREPAID to the Service Department listed below. Be sure to state the model and serial number of the unit from which the parts were removed and date the unit was purchased. These parts will be exchanged at no charge, under the terms of the Warranty.

3. If the above-mentioned procedures do not correct the problem you are experiencing with your unit, pack it securely (preferably in the original carton or double-packed). Enclose a letter describing the problem and include your name and address. Deliver to, or ship PREPAID (UPS preferred) to the nearest B & K-Precision authorized service agency (see list enclosed with unit).

If your list of authorized B & K-Precision service agencies has been misplaced, contact your local distributor for the name of your nearest service agency, or write to:

Service Department

B & K-Precision Product Group
DYNASCAN CORPORATION
2815 West Irving Park Road
Chicago, Illinois 60618

LIMITED ONE-YEAR WARRANTY

DYNASCAN CORPORATION warrants to the original purchaser that its B & K-PRECISION product, and the component parts thereof, will be free from defects in workmanship and materials for a period of one year from the date of purchase.

DYNASCAN will, without charge, repair or replace, at its option, defective product or component parts upon delivery to an authorized B & K-PRECISION service contractor or the factory service department, accompanied by proof of the date of purchase in the form of a sales receipt.

To obtain warranty coverage, this product must be registered by completing and mailing the enclosed warranty registration card to DYNASCAN, B & K-PRECISION, P.O. Box 35080, Chicago, Illinois 60635 within five (5 days) from the date of purchase.

Exclusions: This warranty does not apply in the event of misuse or abuse of the product or as a result of unauthorized alterations or repairs. It is void if the serial number is altered, defaced or removed.

DYNASCAN shall not be liable for any consequential damages, including without limitation damages resulting from loss of use. Some states do not allow limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

This warranty gives you specific rights and you may also have other rights which vary from state to state.

For your convenience we suggest you contact your B & K-PRECISION distributor, who may be authorized to make repairs or can refer you to the nearest service contractor. If warranty service cannot be obtained locally, please send the unit to B & K-PRECISION Service, 2815 West Irving Park Road, Chicago, Illinois 60618, properly packaged to avoid damage in shipment.

B+K PRECISION

DYNASCAN CORPORATION
6460 West Cortland Street
Chicago, Illinois 60635

INSTRUCTION MANUAL

B&K Model 1077

Television Analyst

B&K MODEL 1077 TELEVISION ANALYST
A PRODUCT OF DYNASCAN CORPORATION, CHICAGO, ILLINOIS

A Product of DYNASCAN CORPORATION 1801 West Belle Plaine · Chicago, Illinois 60613
B&K

PRICE $3.00

Dear Friend:

Congratulations on your purchase of B & K — Precision Test Equipment, and welcome to the B & K family. We hope your experience with your new test equipment will make you a lifetime B & K customer.

Your instrument is backed by more than 20 years of experience in designing and manufacturing. Our most important goal is your satisfaction. At B & K, test equipment is made to meet the demands of the field, focusing on dependability and accuracy. We also concentrate on simplicity and operating ease with features that reduce the possibility of human error and speed the servicing process.

In order to determine the type of test units that are needed we have been guided by letters and reports from technicians and engineers who use the equipment daily. Our field tests and studies have helped provide better and faster service techniques. Close contact has been maintained with the manufacturers of consumer products which our test units will be checking and trouble-shooting.

Key personnel in our company cut their eye teeth in the TV service business. This is why we have more "sensitivity" for the problems and conditions under which the test equipment will be used.

B & K product designs are constantly reviewed, and refinements are made or new models developed to meet advances in our industry and to fill your needs. We set our standards high so you can be assured that the B & K test instruments you buy represent advanced design, quality construction, and dependable long-term performance at a price you can afford.

If you have any comments or thoughts about our products, or test equipment in general, I would be delighted to hear from you.

Thanks for your confidence in B & K and we look forward to serving you for a long time to come.

Sincerely,

Carl Korn

Carl Korn
President

INSTRUCTION MANUAL
FOR
MODEL 1077
TELEVISION ANALYST

B & K DIVISION OF DYNASCAN CORPORATION
6460 W. Cortland Street
Chicago, Ill. 60635
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INTRODUCTION

As generally acknowledged in the service business, it is the *approach* to servicing a Television receiver that determines:

1. how quickly you can locate the trouble and fix it . . . especially hard-to-find trouble.
2. how fully you can satisfy your customers.
3. how much you can avoid those unpleasant and unprofitable call-backs.
4. how you can efficiently service more television sets in less time.
5. how, by saving valuable time, you can make *your* time more profitable.

With this in mind, it has been our constant aim to simplify the approach and make the service job easier to accomplish with greater accuracy. This dedication to your needs has grown through actual servicing experience. The practical benefits of each new instrument are pre-tested in the field through the cooperation of leading service shops.

Over the years, this has generated one innovation after another—in simplified techniques, procedures, and instruments to speed the work of the professional and make the beginner-technician more competent.

Among these specialized B & K instruments are: the CRT checker and rejuvenator; the high speed, multiple-socket tube testers; the solid state color generator; the in-circuit out-of-circuit transistor analysts; the diagnostic oscilloscope with vectorscope and intermittent analyzer; the in-circuit out-of-circuit capacitor analyst; the sweep/marker alignment generator; the VOMs and VTVMs; and, of course, the original Television Analyst. Each is designed to do its job faster with greater simplicity and accuracy. Together, they provide an efficient basis for a high quality, professional and profitable service operation.

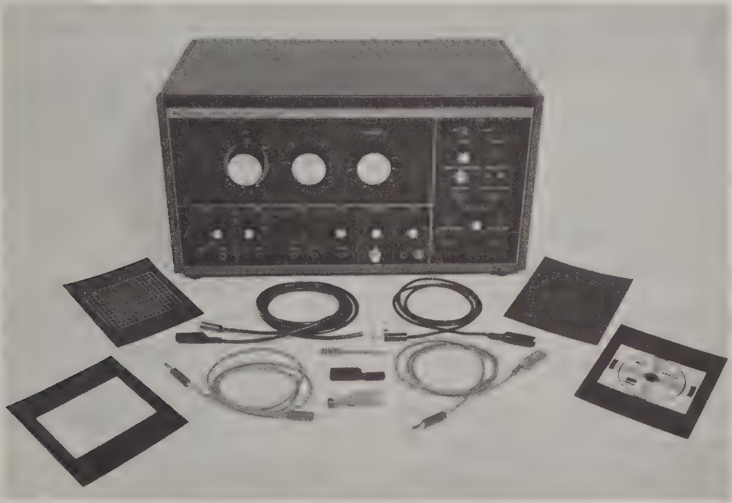
Not only is B & K Test Equipment widely accepted and used by many thousands of servicemen, but by set manufacturers as well. As a result, it has become a standard in the industry.

In this TELEVISION ANALYST, you have today's most versatile and useful TV service instrument. It's like having your own television station. You can inject your own TV signals at any time, at any point —and quickly track down the source of "tough dog", intermittent, or general TV troubles, as you watch the generated test pattern on the screen of the television receiver, or listen to the sound. This applies to black-and-white or color, vhf or uhf, tube-type or transistorized sets. If necessary in particular situations, you can actually demonstrate your servicing procedure and its results to your customers.

The TELEVISION ANALYST checks each circuit in precisely the way that the circuit itself operates, and through the signal substitution technique, it often saves "lost hours" and greatly reduces servicing time.

This comprehensive Manual is designed to simplify your use of the TELEVISION ANALYST. It takes you step-by-step through the various stages of operation and covers procedures, symptom analyses, and troubleshooting techniques.

The *Troubleshooting Procedures* section with its condensed charts, for example, gives you a quick point of reference as to symptoms, causes, and procedures which are covered in more detail in other sections. The complete Manual thus becomes a most valuable and helpful guide in servicing television receivers.



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ADVANTAGES IN USING THE TELEVISION ANALYST

The TELEVISION ANALYST is an instrument that permits a service technician to quickly and accurately locate troubles in television receivers by the "signal substitution" technique. It is designed for analyzing black-and-white and color, vhf and uhf, tube-type and transistorized television receivers. This "signal substitution" technique of troubleshooting can often cut servicing time in half, or more, compared to any other troubleshooting method. The time saved, in turn, means more profitable television servicing. The technique quickly and accurately locates the section and stage of the television receiver with the malfunction, and many times locates the specific component that is defective. With the TELEVISION ANALYST, only one instrument is required for locating troubles in any section of the television receiver.

When there is trouble in a television receiver, a signal is absent or abnormal somewhere between the antenna and the picture tube or speaker. With the signal substitution method, a normal signal is injected into suspected stages where it substitutes for the absent or abnormal signal. If the injected signal restores operation, we know the trouble is located between the point of injection and the antenna. If the injected signal has no effect, we know the trouble is located between the point of injection and the picture tube or speaker.

The TELEVISION ANALYST is primarily intended for use in the television service shop. Tube testing during the service call in the home, of course, continues to be the first step in television servicing for vacuum tube receivers. (In color television especially, tube replacements may reveal or generate other problems that require critical analysis and correction.) When tube replacement and other short cuts do not correct the trouble, shop servicing is required. This is where the TELEVISION ANALYST provides the fastest method yet developed for locating otherwise hard-to-find troubles.

As more and more transistorized television receivers come on the market, the servicing job takes on some new aspects. Tube replacement, of course, does not apply. What, then, will make it easier to service transistorized sets? Here again the TELEVISION ANALYST, with its signal substitution technique and its complete versatility, becomes the ideal instrument because it provides low impedance signal outputs which are necessary for transistor circuits.

WHAT THE TELEVISION ANALYST WILL DO

1. Simplifies complete servicing on all black-and-white or color television receivers through use of a single test instrument.
2. Speeds servicing of transistorized, partially transistorized, and vacuum tube television receivers, including uhf and vhf tuners.
3. Generates all signals normally transmitted by a television station and those produced within a television receiver for point-by-point signal substitution troubleshooting techniques throughout a complete television receiver.
4. Generates uhf signals on channels 14 through 83 for testing uhf tuners.
5. Generates vhf signals on channels 2, 3, 4, 6, 7, 8, 12, and 13 for testing vhf tuners.
6. Generates i-f signals of 20 to 48 MHz for testing i-f amplifier stages.
7. Generates a positive or negative composite video signal for injection into video stages.
8. Generates a keyed color bar pattern which modulates the R.F. output for troubleshooting and adjusting color circuits.
9. Generates a color rainbow signal for injection into color amplifiers and demodulators.
10. Generates a 4.5 MHz sound channel test signal that is frequency modulated by a 1 KHz audio tone.
11. Generates a 1 KHz tone for audio circuit testing.
12. Generates composite sync pulse signals of positive or negative polarity, adjustable in amplitude, and with variable impedance for troubleshooting sync circuits, picture tubes, blanking circuits and transistorized keyed AGC circuits.
13. Generates vertical grid drive signal for troubleshooting vertical sweep circuits.
14. Generates vertical plate drive signal for checking vertical output transformers.
15. Generates solid state sweep drive signal for checking vertical and horizontal sweep circuits and vertical yoke windings.
16. Generates horizontal grid drive signal for troubleshooting horizontal sweep circuits.
17. Generates horizontal plate drive signal for checking horizontal output (flyback) transformers.
18. Provides B+ boost indication.
19. Provides high voltage indication.
20. Checks flyback transformers, horizontal deflection yokes, and width coils for shorted turns.
21. Generates a high level keying pulse for testing keyed circuits, AGC, burst amplifiers and blanking.
22. Provides positive or negative dc bias voltages, variable in amplitude, from a low impedance power supply which is completely isolated from the TELEVISION ANALYST chassis.
23. Provides a stable signal source for locating intermittent troubles.
24. Generates a test pattern for color convergence adjustments.
25. Generates test pattern for horizontal and vertical linearity, size, and aspect ratio checks and adjustment.
26. Checks bandwidth, resolution, shading, and contrast capabilities of television receivers.
27. Will reproduce any 3" x 4" positive transparency as a picture source to demonstrate the performance capabilities of television receivers.
29. Will display pictures on the screens of television receivers as an advertising medium.
30. Can be used as a transmitter for video paging at conventions, hospitals, and other gatherings.
31. Checks the performance of community and master antenna systems.

SPECIFICATIONS—TELEVISION ANALYST

Input Power	100 watts, 117 volts, 60 Hz ac
IF Output	20 to 48 MHz 0 to 70,000 microvolts minimum @ 75 ohms
VHF Output Channels 2 to 6	0 to 12,000 microvolts minimum @ 75 ohms
Channels 7 to 13	0 to 6,000 microvolts minimum @ 75 ohms
UHF Output	Channels 14 to 83 0 to 1,000 microvolts minimum @ 75 ohms
Video Output	composite signal 0 to 2.5 volts peak-to-peak minimum @ 1,000 ohms positive or negative polarity
Sync Output	0 to 50 volts peak-to-peak logarithmically variable impedance 10 K ohms @ 50 volts 1 K ohm @ 10 volts positive or negative polarity
4.5 MHz Output	frequency modulated by 1 KHz audio tone at 25 KHz deviation; @ 180 ohms
1 KHz Output	at least 1 volt peak-to-peak across 300 ohms
Color Output	crystal controlled 3,563,795 Hz ½ to 5 volts peak-to-peak 100 ohms @ min. volts 1,000 ohms @ max. volts
Bias Power Supply	positive or negative polarity 0 to 25 volts into infinite load 0 to 250 ma @ 50 ohms ungrounded

Vertical Grid Drive Output	60 Hz 0 to 150 volts peak-to-peak
Vertical Solid State Sweep Output	60 Hz 17.5 volts peak-to-peak @ 50 ohms
Horizontal Grid Drive Output	crystal controlled 15,750 Hz ± 0.5% 150 volts peak-to-peak minimum
Horizontal Solid State Sweep Output	15.75 KHz 11 volts peak-to-peak @ 2.5 ohms
AGC Keying Pulse Output	15,750 Hz 400 volts peak-to-peak @ 30 K ohms
Vertical Plate Drive Output	sufficient to drive all vacuum tube circuit vertical transformers
Horizontal Plate Drive Output	sufficient to drive all vacuum tube circuit flyback transformers
Dimensions	9¾″ high 18″ wide 12″ deep
Weight	26 pounds

In this manual, frequencies are specified in Hertz (Hz). Hertz is a recent term, now used throughout the electronics industry, which is replacing "cycles per second".

New Term	*Old Term*
Hertz (Hz)	cycles per second (cps)
kiloHertz (KHz)	thousand cycles per second or kilocycles (kc)
megaHertz (MHz)	million cycles per second or megacycles (mc)

OPERATOR'S CONTROLS

(See Figure 2)

1. UHF control—selects uhf channel
2. IF control—selects i-f frequency
3. RF SELECTOR—selects i-f, uhf, or vhf operation and vhf channel
4. VIDEO POLARITY switch—selects video polarity (video output only)
5. VIDEO control—adjusts video level
6. GROUND jack—ground connection
7. VIDEO jack—video output signal
8. SYNC control—adjusts sync output level
9. SYNC POLARITY switch—selects sync polarity
10. SYNC jack—sync output signal
11. AUDIO ON-OFF switch—turns on and off 4.5 MHz and audio modulation of rf output signal.
12. 4.5 MHz jack—4.5 MHz sound i-f output signal
13. 1 KHz jack—1 KHz audio output signal
14. COLOR control—turns on and off color generator and adjusts color output level
15. COLOR jack—color output signal
16. RF ATTENUATOR control—adjusts level of vhf, uhf and i-f output signal.
17. RF jack—i-f, vhf, and uhf output signal
18. BIAS control—adjusts votlage output of bias power supply
19. POSITIVE BIAS jack—positive connection to bias power supply
20. NEGATIVE BIAS jack—negative connection to bias power supply
21. TEST INDICATOR lamp—horizontal yoke and flyback transformer shorted turns indicator
22. CALIBRATE control—calibrates the TEST INDICATOR circuit
23. FLYBACK and YOKE TEST SIGNAL jack — shorted turns test signal
24. BOOST INDICATOR lamp—B+ boost indicator
25. PLATE DRIVE jack — horizontal and vertical plate drive test signal
26. HORIZ-OFF-VERT switch—selects horizontal or vertical PLATE DRIVE signal and horizontal or vertical SOLID STATE SWEEP DRIVE signal (when not in use, leave in OFF position)
27. KEYING PULSE jack — agc keying pulse test signal
28. SOLID STATE SWEEP DRIVE jack and vertical deflection yoke test signal
29. HORIZ GRID DRIVE jack—horizontal grid drive test signal
30. AMPLITUDE control—adjusts level of vertical grid drive signal, the vertical plate drive signal and the SOLID STATE SWEEP DRIVE signal. (Both horizontal and vertical)
31. VERT GRID DRIVE jack—vertical grid drive test signal
32. OFF-STBY-ON switch—power OFF, to filaments only (STBY), or ON
33. PILOT lamp—lights in STBY and ON positions
34. GROUND jack—ground connection

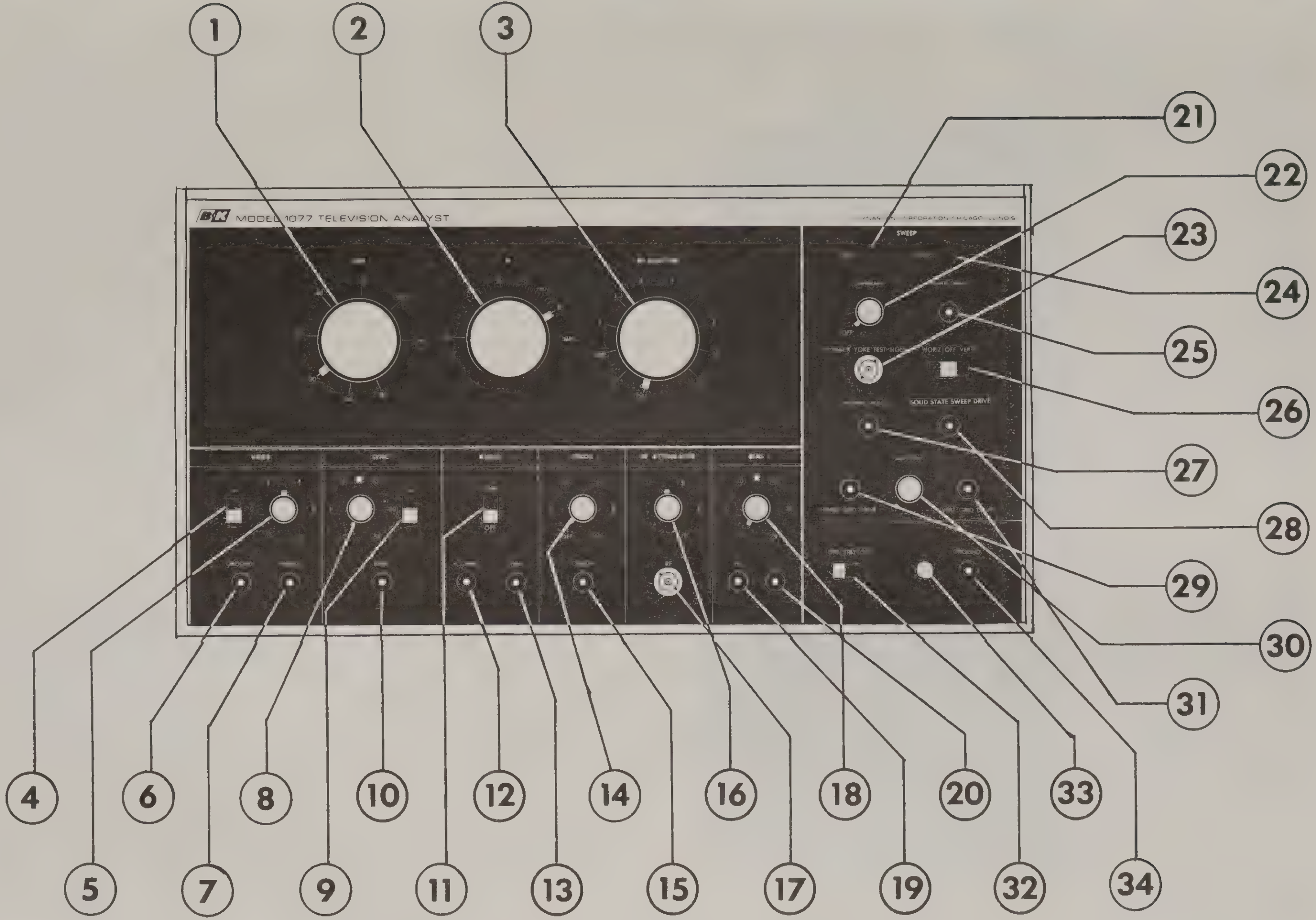


Figure 2. Operator's Controls

TYPICAL OPERATING PROCEDURE

Before you begin troubleshooting with the TELEVISION ANALYST you will need to become familiar with its controls, the various types of signals it can generate, and how the signals can be used. To become familiar with the controls and their operation, it is recommended that the TELEVISION ANALYST and an operating television receiver (adjusted for best reception of a local channel) be set up on a bench. A color television receiver with both vhf and uhf reception is preferred. To best demonstrate the capabilities of the TELEVISION ANALYST, a vacuum tube type television receiver is recommended. Tubes may be easily removed to simulate troubles, and injection of the proper test signal from the TELEVISION ANALYST should restore proper operation.

The procedures are divided into groups; one group for each type of signal that the TELEVISION ANALYST generates. These procedures demonstrate the use of all controls and signals, and typical signal amplitudes at various points in a television receiver.

NOTE

In this manual, names of controls appearing in all capital letters represent controls on the TELEVISION ANALYST. Example: adjust the COLOR control. Names of controls that are underlined represent controls on the television receiver. Example: set the contrast control.

Until the owner becomes familiar with the TELEVISION ANALYST, the controls may be set to the following positions. These settings are a combination of the most commonly used frequencies, disabling of all unused functions, typical signal levels, and minimum amplitude of all outputs that might damage transistorized circuits if used at high levels. For these reasons, it is recommended that the new owner return the controls to these reference settings upon completion of testing. Once he has become familiar with the controls, he may easily devise his own reference settings.

The OFF-STBY-ON switch can be left in the STBY position when the instrument is not in use. This eliminates any wait for warm-up the next time it is used. In the STBY position, all outputs (except bias supply) are disabled and power is applied only to the filaments of the tubes in the TELEVISION ANALYST.

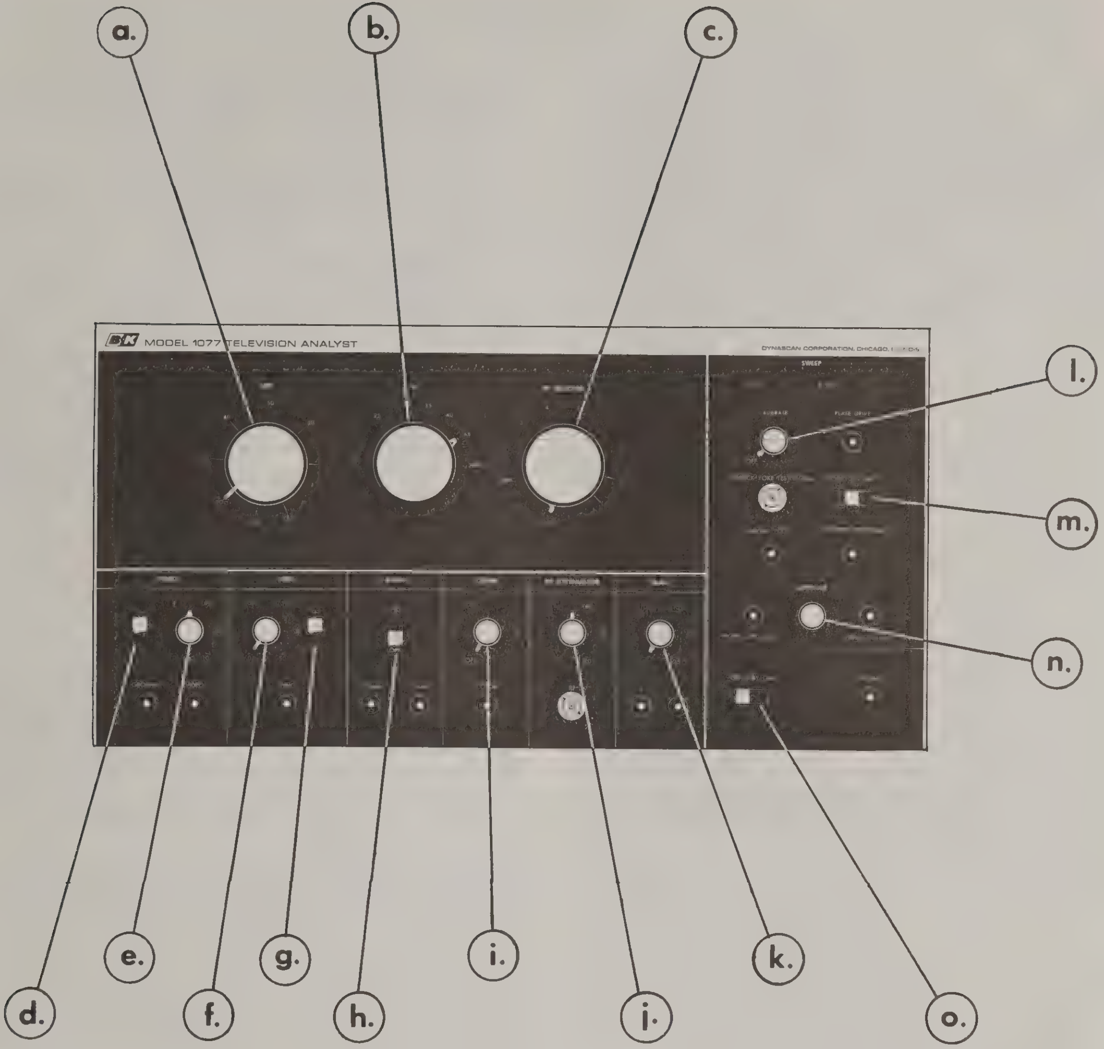


Figure 3. Initial Control Settings

a. UHF control to 20
b. IF control to 45
c. RF SELECTOR to OFF
d. VIDEO POLARITY switch to POSITIVE
e. VIDEO control to 5
f. SYNC control to 0
g. SYNC POLARITY switch to POSITIVE
h. AUDIO ON-OFF switch to OFF
i. COLOR control to OFF
j. RF ATTENUATOR control to 5
k. BIAS control to 0
*l. CALIBRATE control to OFF
*m. HORIZ-OFF-VERT switch to OFF
n. AMPLITUDE control to midposition between min and max
o. OFF-STBY-ON switch to OFF

*Always turn OFF when not in use

A. VHF SIGNAL

(See Figures 3-4-5-6-7-8)

The vhf signal will probably be the most commonly used signal in troubleshooting. Every troubleshooting procedure should start with injection of a vhf test signal at the antenna terminals of the faulty television to completely check the symptoms. Proper analysis of the test pattern can localize the trouble, showing which stages require additional troubleshooting. It also shows when alignment or adjustment is required. While injecting many other types of signals, the vhf signal continues to be injected at the antenna terminals. (See Figures 4 and 5.)

1. Set the controls on the TELEVISION ANALYST to the following positions before applying power:

   AUDIO ON-OFF switch to OFF

   COLOR control to OFF

   RF ATTENUATOR control to 5

   CALIBRATE control to OFF

   HORIZ-OFF-VERT switch to OFF

   OFF-STBY-ON switch to OFF

2. Plug the power cords of the TELEVISION ANALYST and the television receiver into 117-volt, 60-Hz, outlets.
3. Set the OFF-STBY-ON switch to STBY (standby). The pilot lamp will light. Allow the TELEVISION ANALYST to warm up for two or three minutes. The STBY position applies power only to the filaments of the tubes in the TELEVISION ANALYST.
4. Connect the coaxial test lead from the RF jack to the vhf ant. terminals after disconnecting any antenna that may be connected to the terminals.
5. Open the cover of the TELEVISION ANALYST and insert the test pattern slide into the slide track. Push it all the way down. The side of the slide on which "FRONT" appears correctly should face the photomultiplier tube.
6. Set the OFF-STBY-ON switch to ON.
7. Turn the television receiver on and allow it to warm up for two or three minutes.
8. Set the RF SELECTOR on the TELEVISION ANALYST and the channel selector on the television receiver to the same unused channel, preferably below channel 7. A video test pattern should appear on the television receiver picture tube.

   NOTE

   Do not use channels on which local television stations transmit. Sufficient signal may be present to interfere with the test pattern signal.

9. Adjust the fine tuning control for the best picture as you would tune in a television station.
10. Set the brightness and contrast controls at normal positions.
11. Adjust the VIDEO control for good contrast and a full range of grays around the center of the test pattern.
12. Set the AUDIO ON-OFF switch to ON. A 1 KHz audio tone should be heard from the speaker of the television receiver.
13. Adjust the volume control for a comfortable listening level.

Now that a test pattern has been obtained, adjust some of the controls to see the effect upon the picture.

Turn the VIDEO control in both directions and note the effect upon contrast. As the control is turned toward 0, there is less contrast and the picture becomes very light. As the control is turned toward 10, contrast increases and grays become dark or black. Too much signal may cause the picture to distort. Return the control to a setting which shows a full range of grays.

NOTE

Slides or photographs with greater or less density than the test pattern require a different VIDEO setting.

Turn the RF ATTENUATOR control in both directions and note the effect upon the picture. As the control is turned toward 0, the test pattern becomes snowy, then loses horizontal sync, and finally disappears entirely. As the control is turned toward 10, the picture becomes sharper and contrast increases. Return the control to the setting which gives the best picture.

Turn the RF SELECTOR on the TELEVISION ANALYST and the channel selector on the television receiver to other vhf channels on which local broadcasts are not carried, always tuning both to the same channel. A video test pattern and audio tone of good quality should be maintained on each channel. Adjustment of the fine tuning control and RF ATTENUATOR control may be necessary to obtain the best picture.

Thus far, controls have been set to provide the best possible display of the test pattern. When the display is compared to a perfect test pattern, overall performance of the television set is checked. It shows whether adjustments or alignment are necessary, and whether circuits are performing satisfactorily. If any abnormal indications are discovered during the following checks (see Figure 6), refer to the *Performance Testing* section of this manual for corrective measures.

a. The center of the test pattern display should be at the physical center of the screen.

b. The black circle should just fill the screen vertically.

c. The black outer circle and gray inner circles should be perfectly round.

d. The shades of gray in the circles around the center should be easily distinguishable from each other.

e. The vertical wedges extending from the center to the top and bottom of the screen will merge and be indistinguishable near the center. Near the outside, they can be easily distinguished from each other. Lines should be distinguishable at 3 or higher on the top scale (bandwidth 3 MHz or greater), 250 or higher on the bottom scale (resolution 250 lines or greater).

f. There should not be a black smear at the right edge of the three black bars.

g. There should be no ringing (multiple lines similar to ghost images) on the right edge of the vertical wedges.

If the vhf signal is applied to a color television receiver, the remaining steps of this procedure should be followed (see Figure 7):

14. Remove the test pattern slide from the TELEVISION ANALYST.
15. Turn the COLOR control to position 1 (turns on color generator). A color bar pattern will be displayed on the picture tube. Rotating the COLOR control from 1 to 10 has no effect upon the color bar pattern.
16. Adjust the color control for normal brilliance of colors. No more than ⅓ of the full setting should be required.
17. Adjust the hue control for the correct colors as shown in figure 7. The first and tenth color bars may not be visible on all television receivers. Adjustment of the horizontal hold control will usually shift the horizontal centering enough to show the outside bars.

Examine the color bar pattern displayed on the screen and check it for the following criteria:

—the correct colors are displayed

—the color bars fit within the black registration lines on each side of the bars (tests delay line)

—color bars are stable (a defective afc circuit can cause a "barber-pole" effect)

18. Reinsert the test pattern slide and notice that the black and white test pattern and the color bar pattern are both present on the display. This demonstrates the ability of the television receiver to display both black and white signals and color signals. (See Figure 8.)
19. The AUDIO ON-OFF switch may be in either position, as desired, during this test. In the ON position, all functions of the television receiver are tested: video, color, and sound.

The TELEVISION ANALYST can generate a vhf carrier signal either unmodulated or modulated with video, audio, or color signals. The modulation signals can be used individually or in any combination. When audio and color signals are used simultaneously, a 920 KHz "beat" signal is seen on the color display. Notice the difference when the AUDIO ON-OFF switch is changed from ON to OFF. This "beat" signal is the result of the difference between the 4.5 MHz audio i-f signal and the 3.58 MHz color i-f signal. The "beat" pattern is produced from commercially broadcast television signals as well as from those generated by the TELEVISION ANALYST, although suppression of the 3.58 MHz carrier in commercial broadcasting subdues the effect. The "beat" signal can be used to test the effectiveness of the 920 KHz trap, present in all television receivers (including black and white sets) to filter out the "beat" signal. The test is performed by comparing the amount of "beat" present in a particular television receiver with the amount normally present on other receivers.

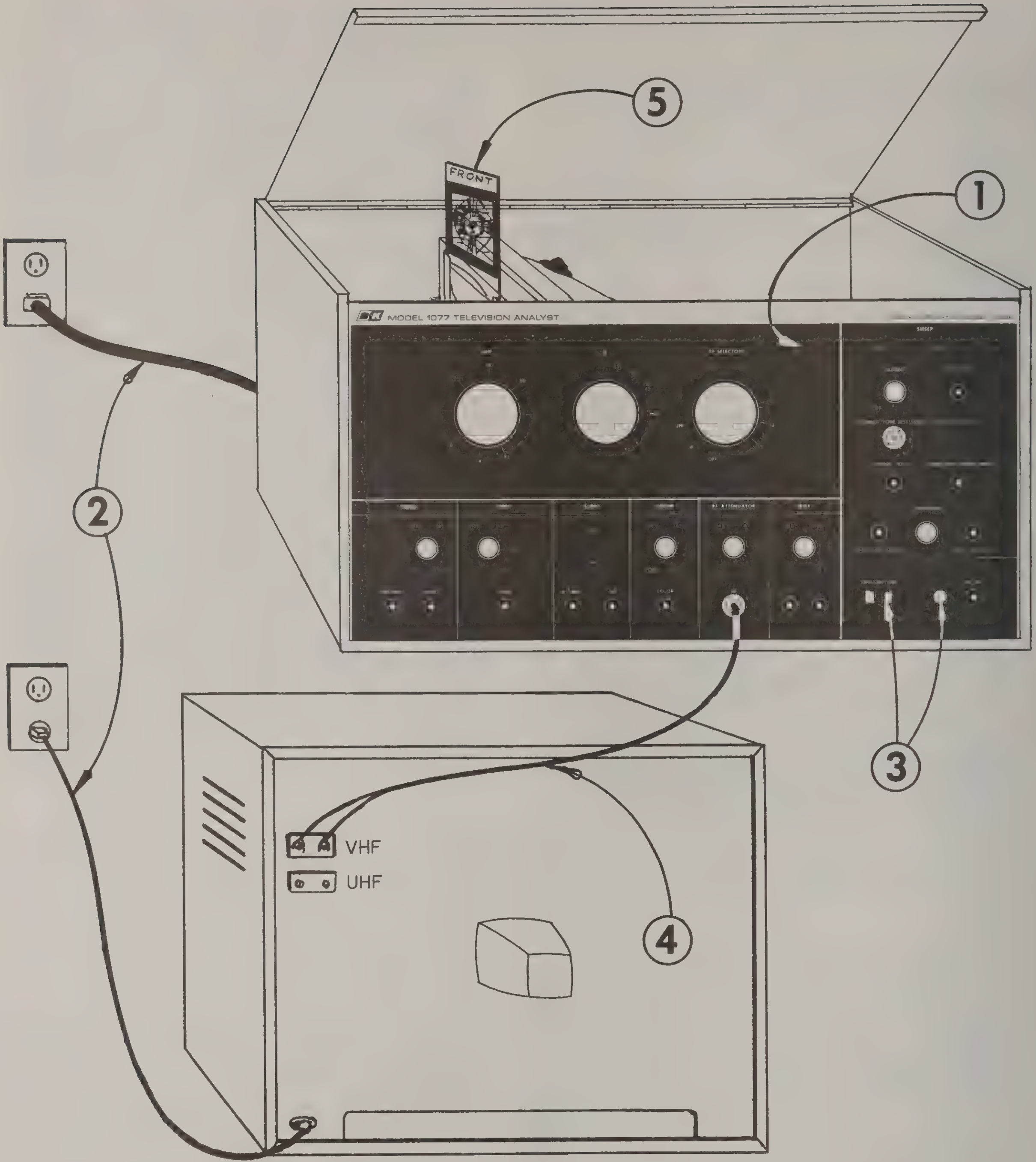


Figure 4. Connections for VHF Signal

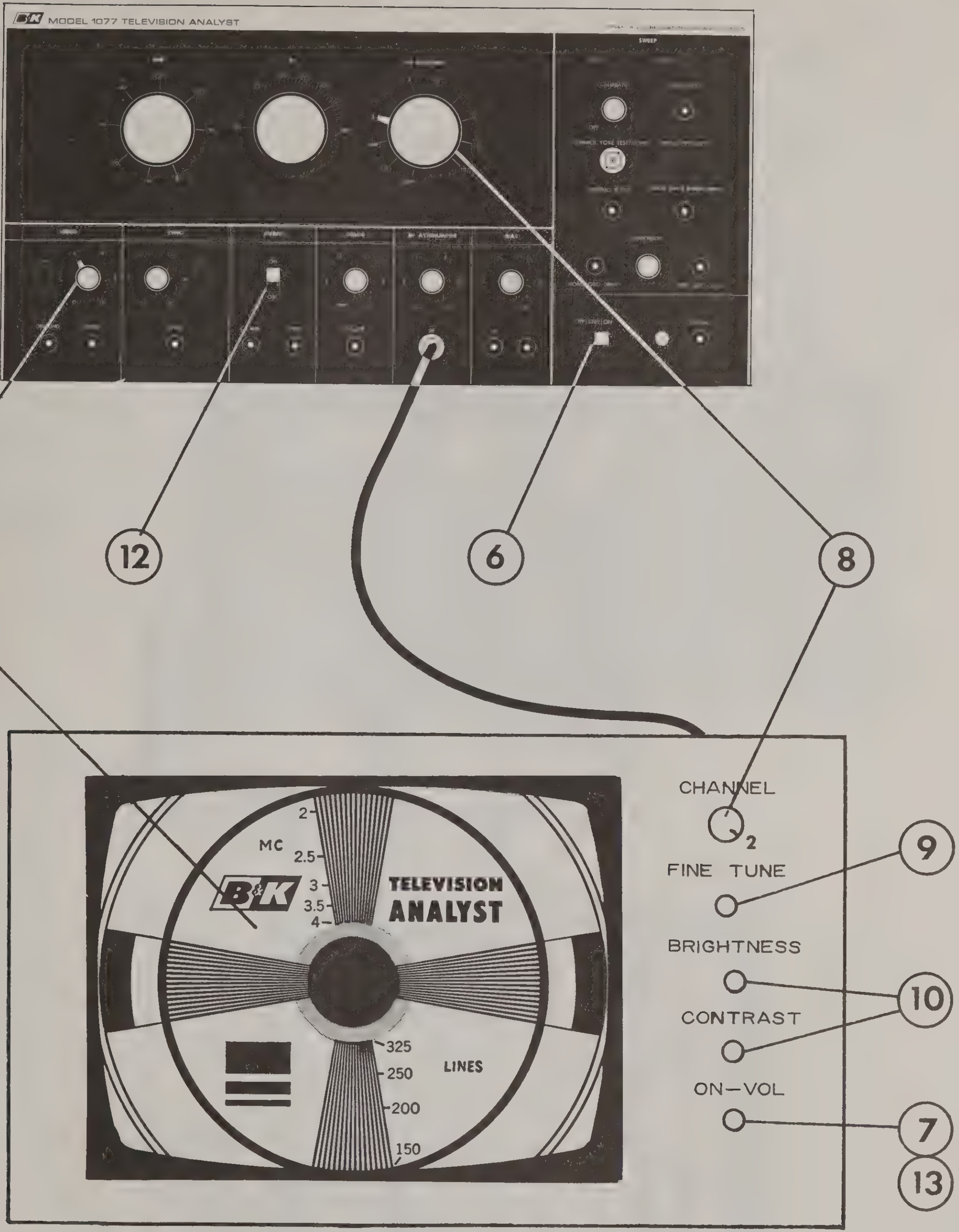


Figure 5. Control Settings for VHF Signal

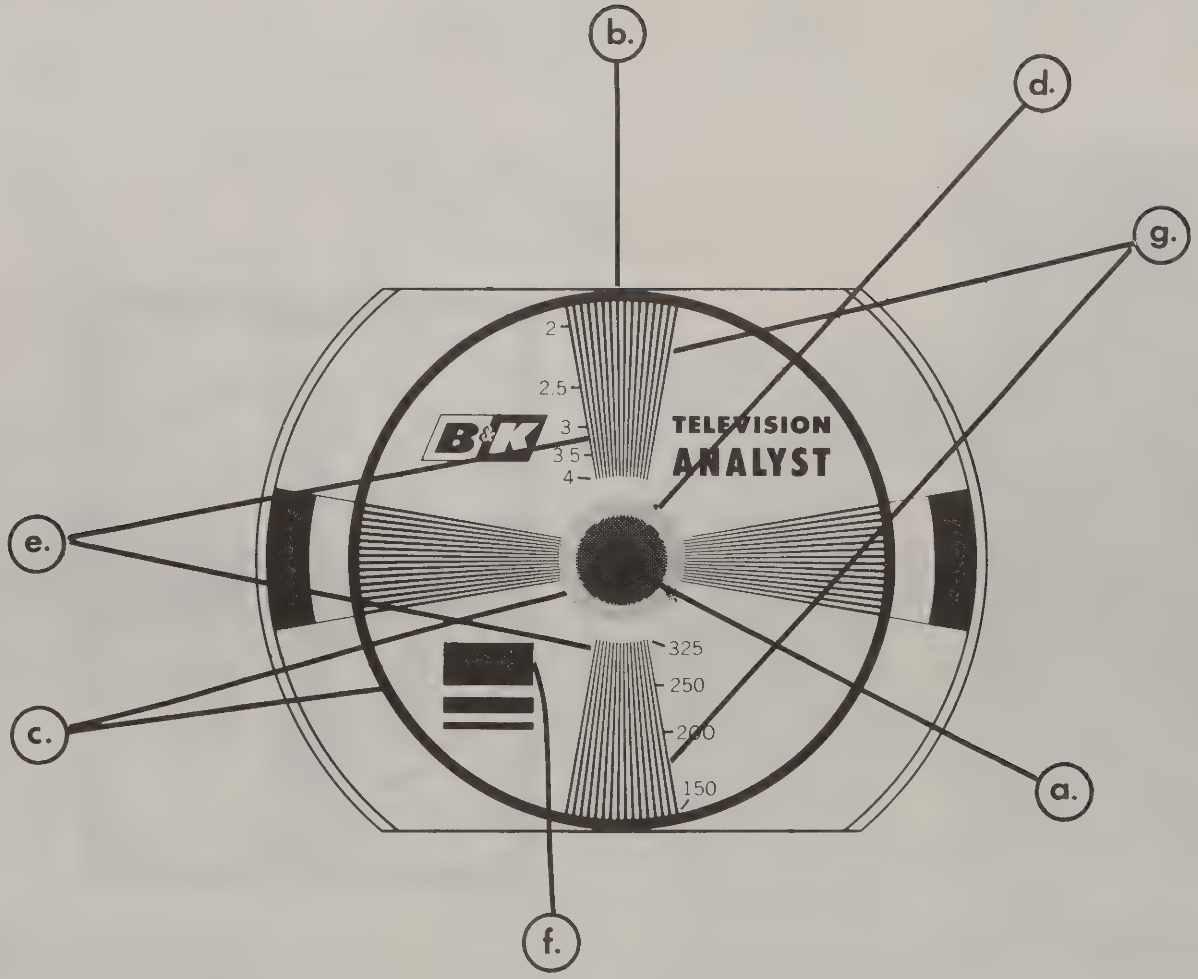


Figure 6. Compare Display to This Test Pattern

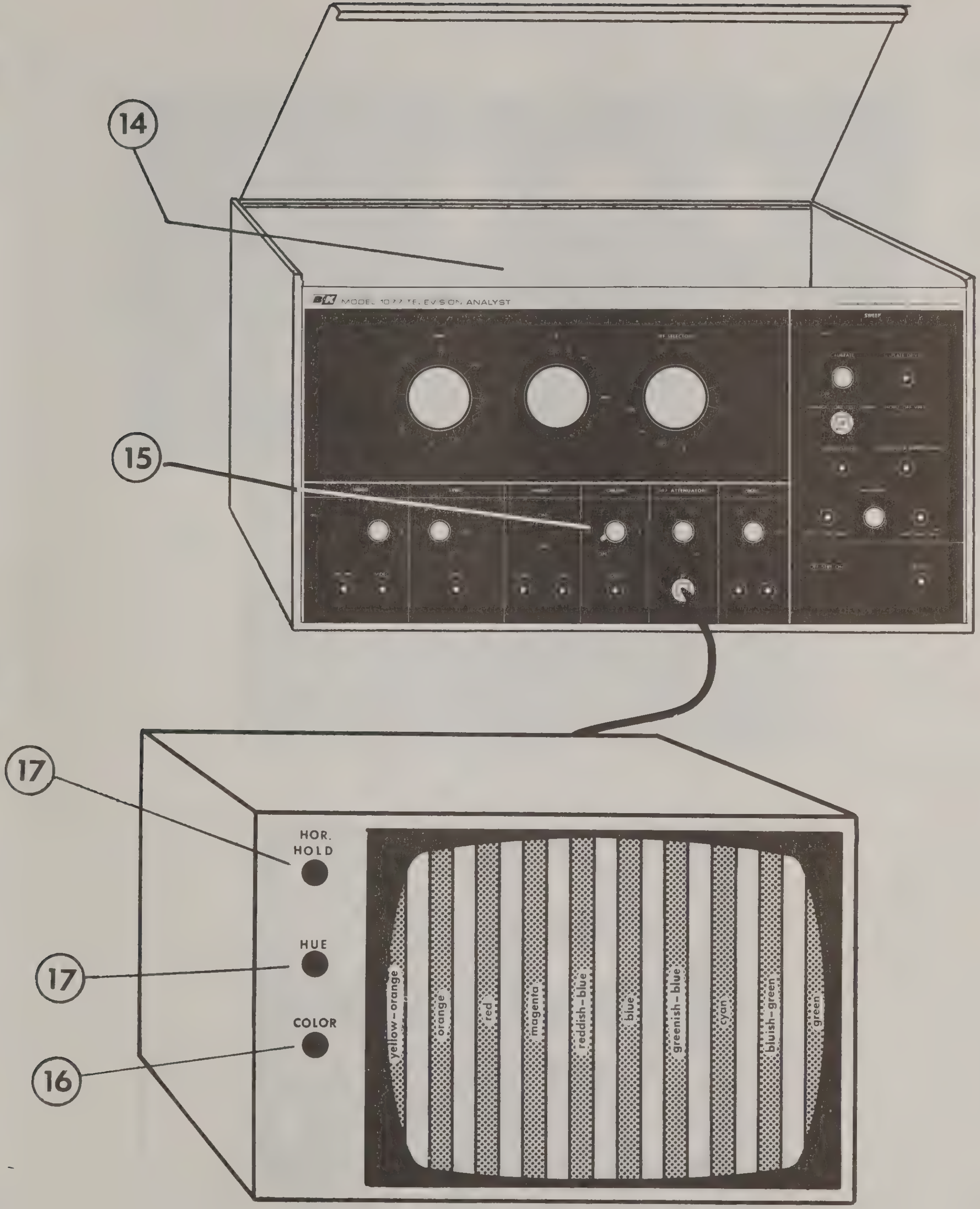


Figure 7. Control Settings for Color Test with VHF Signal

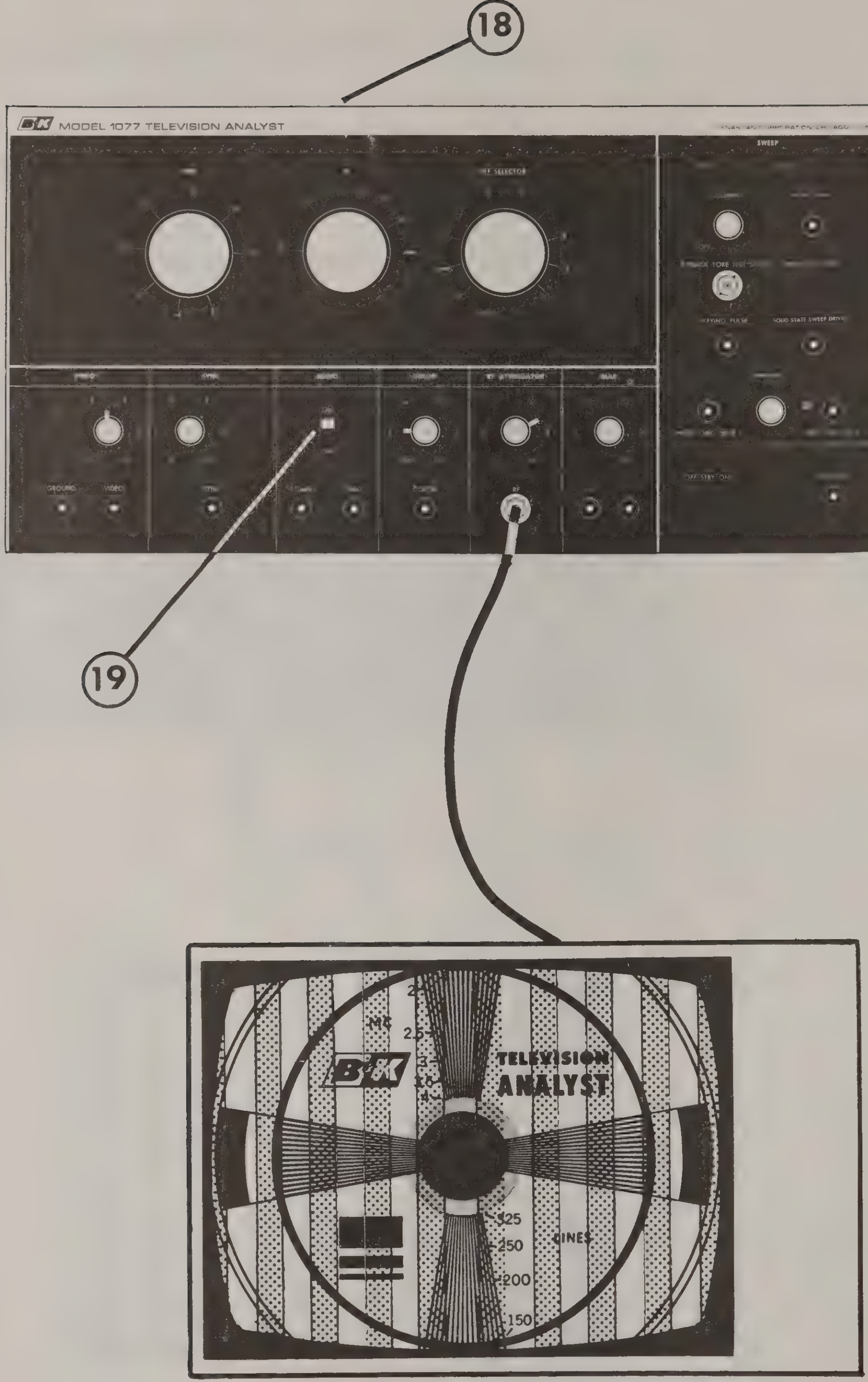


Figure 8. Black and White Video Test Pattern and Color Bar Pattern Superimposed

B. UHF SIGNAL

(See Figure 9)

1. Remove the coaxial test lead connections from the vhf ant. terminals and connect them to the uhf ant. terminals.
2. Set the RF SELECTOR to the UHF position.
3. Set the UHF control to an unused uhf channel on the low end of the band (channel 14 to 20).
4. Set the channel selector to uhf.
5. Tune the uhf tuning control to the same channel that was selected on the TELEVISION ANALYST. The video test pattern should be displayed and the audio test tone should be heard on the television receiver (AUDIO switch ON). Tune for the best picture.
6. Adjust the VIDEO and RF ATTENUATOR controls for the best picture. Varying these controls has the same effect as with vhf signals.

Adjust the UHF control from the low end to the high end of the band, stopping about every five channels. Tune the television receiver to the same channel at each stop. The video test pattern and audio test tone should retain the same quality throughout the tuning range.

The COLOR test can be performed exactly as that described for vhf signals.

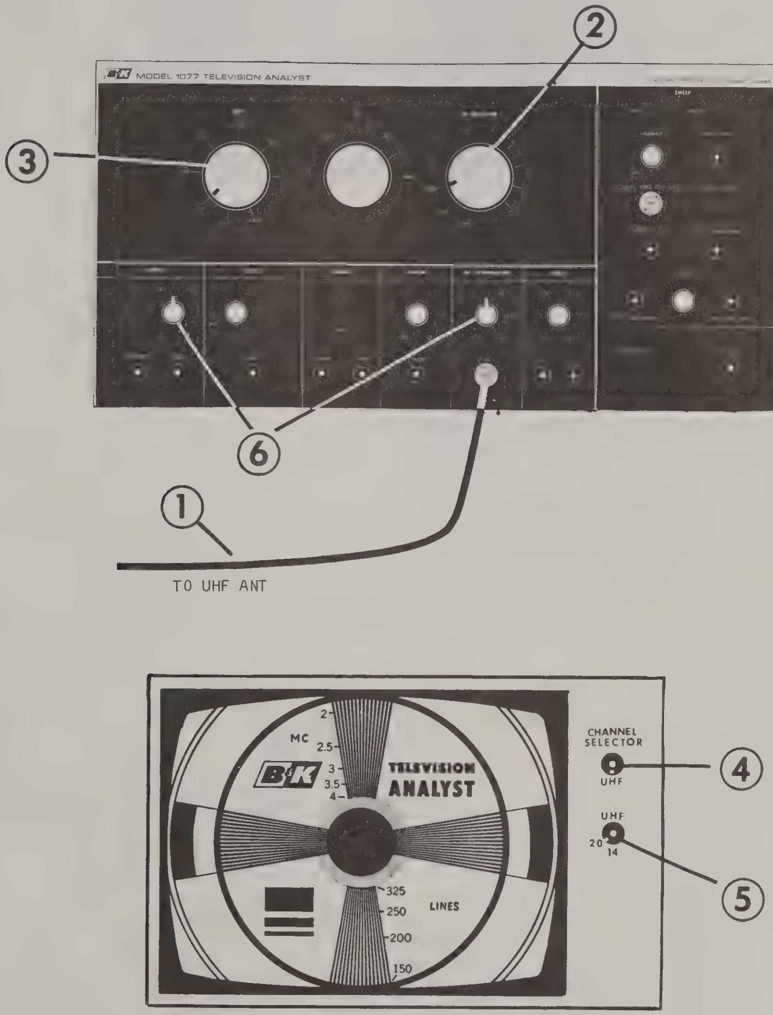


Figure 9. Connections and Control Settings for UHF Signal

C. IF SIGNAL

(See Figures 10-11-12)

Beginning with the i-f test signal, the remaining test signals described in the *Typical Operating Procedure* require access to circuits in the chassis. A schematic diagram of the television receiver will probably be required for locating all test points.

1. Disconnect the coaxial test lead from the uhf ant. terminals and unplug the power cord of the television receiver.
2. Remove the back and cabinet of the television receiver, as required, for access to the chassis. Disable the tuner by removing the i-f input plug from the i-f amplifier or equivalent.
3. Reapply power with a cheater cord.

   WARNING

   WHENEVER TESTING TRANSFORMERLESS TELEVISION RECEIVERS, CONNECT A 1:1 ISOLATING TRANSFORMER IN THE POWER LINE BETWEEN THE TV SET AND THE AC OUTLET. SERIOUS SHOCK MAY RESULT IF THIS SAFETY PRECAUTION IS IGNORED. (See Figure 10)
4. Connect the black test lead from the GROUND jack to the chassis of the television receiver.
5. Connect the coaxial test lead to the RF jack. Connect the black clip of the coaxial test lead to the chassis of the television receiver. Connect the red clip of the coaxial test lead to the input of the 3rd i-f amplifier.
6. Set the RF ATTENUATOR control to 10. The maximum setting of the control is required because the signal is not amplified by the 1st and 2nd i-f amplifiers.
7. Set the RF SELECTOR to the IF position. This engages the IF tuning control and provides an i-f signal at the RF jack.
8. Adjust the IF control to the intermediate frequency (i-f) of the television receiver. Most sets have a 45 MHz i-f, but some older sets operate in the 25 MHz region. When the IF control is adjusted to the proper frequency, the test pattern will be displayed on the screen. Tune the IF control for the best picture.

The VIDEO and COLOR controls have the same effect as with vhf and uhf signals. If the AUDIO switch is ON, the audio test tone may or may not be heard, depending upon the design of the circuit. In some sets, audio and video separation precede the video detector and the audio will not be heard. In practically all sets, the audio will be heard when the i-f signal is injected into the 3rd i-f amplifier.

9. Reduce the setting of the RF ATTENUATOR control until snow is present in the display. Note the setting of the control.
10. Move the red clip of the coaxial test lead from the 3rd i-f amplifier to the input of the 2nd i-f amplifier. The snow should disappear. This demonstrates the amplifying ability of the stage.
11. Again reduce the setting of the RF ATTENUATOR control until snow is present in the display. Note the difference between the setting in step 9 and step 11. The difference represents the amount of relative gain. The greater the difference, the greater the gain. All amplifiers should exhibit gain; experience will show the gain to be expected of various types of amplifiers. Note the gain of this stage as typical reference for future troubleshooting.

    NOTE

    In a few cases, large differences in impedance between the two signal injection points produce an indication of "apparent" loss instead of gain.
12. Repeat the gain measurement procedures for each of the i-f amplifier stages. For each stage, move the red lead of the coaxial test lead one stage toward the antenna. The mixer will exhibit little gain, but it can be tested by applying an i-f signal to its input.

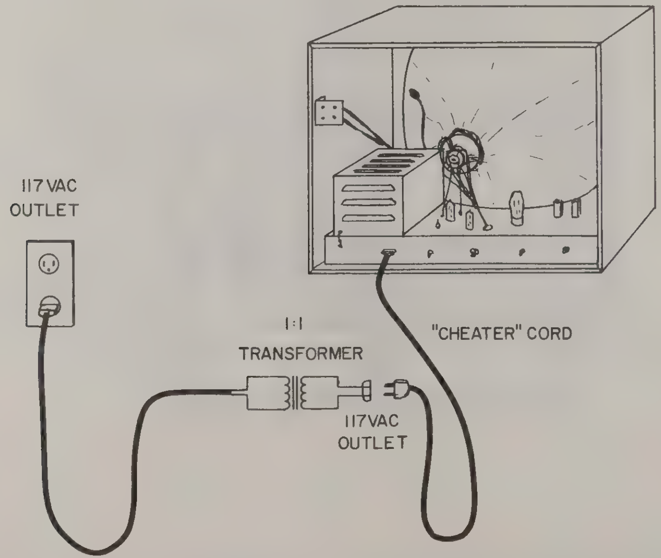


Figure 10. Safety Connections for Transformerless Television Receiver

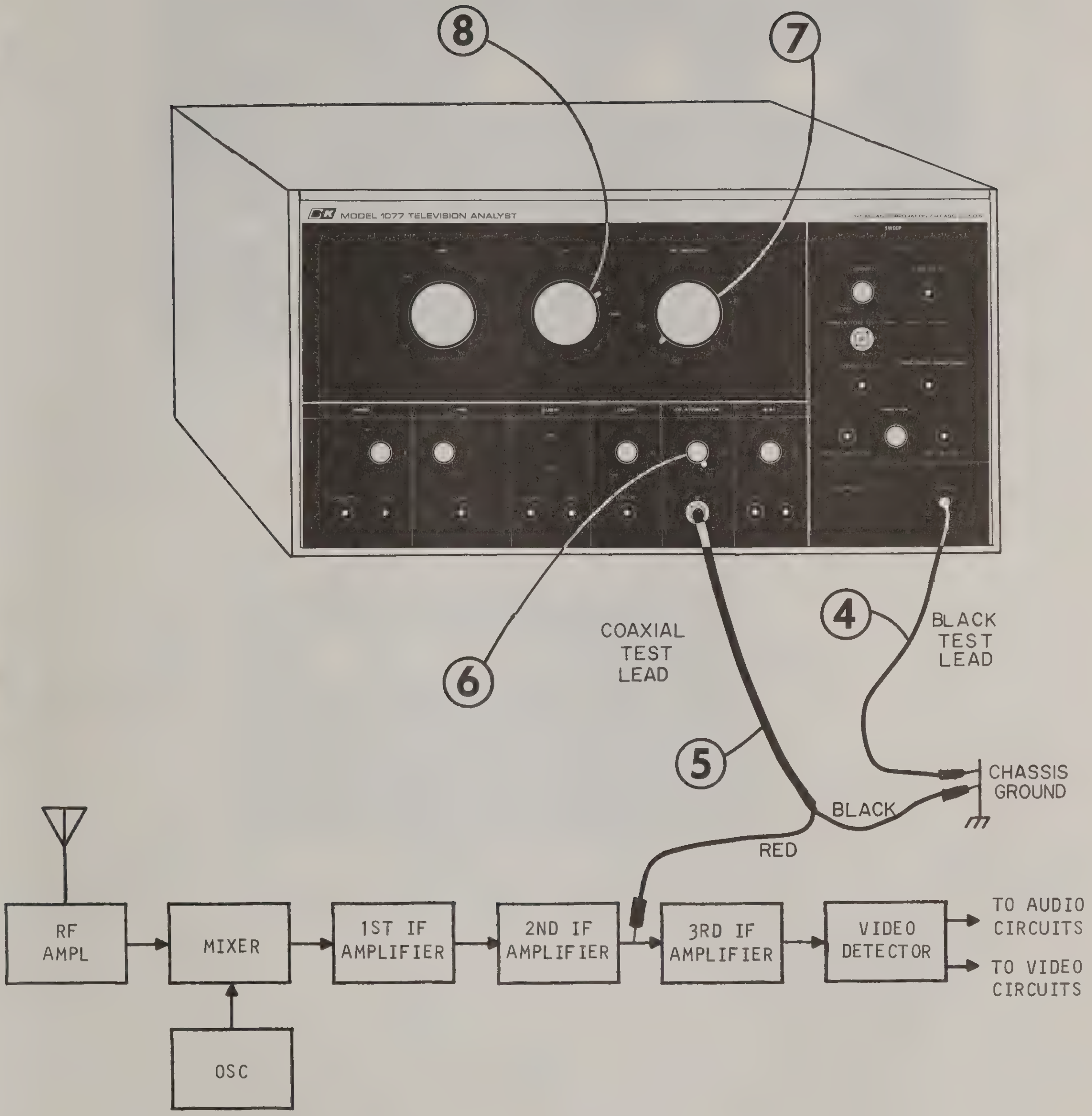


Figure 11. Connections and Control Settings for IF Test Signal

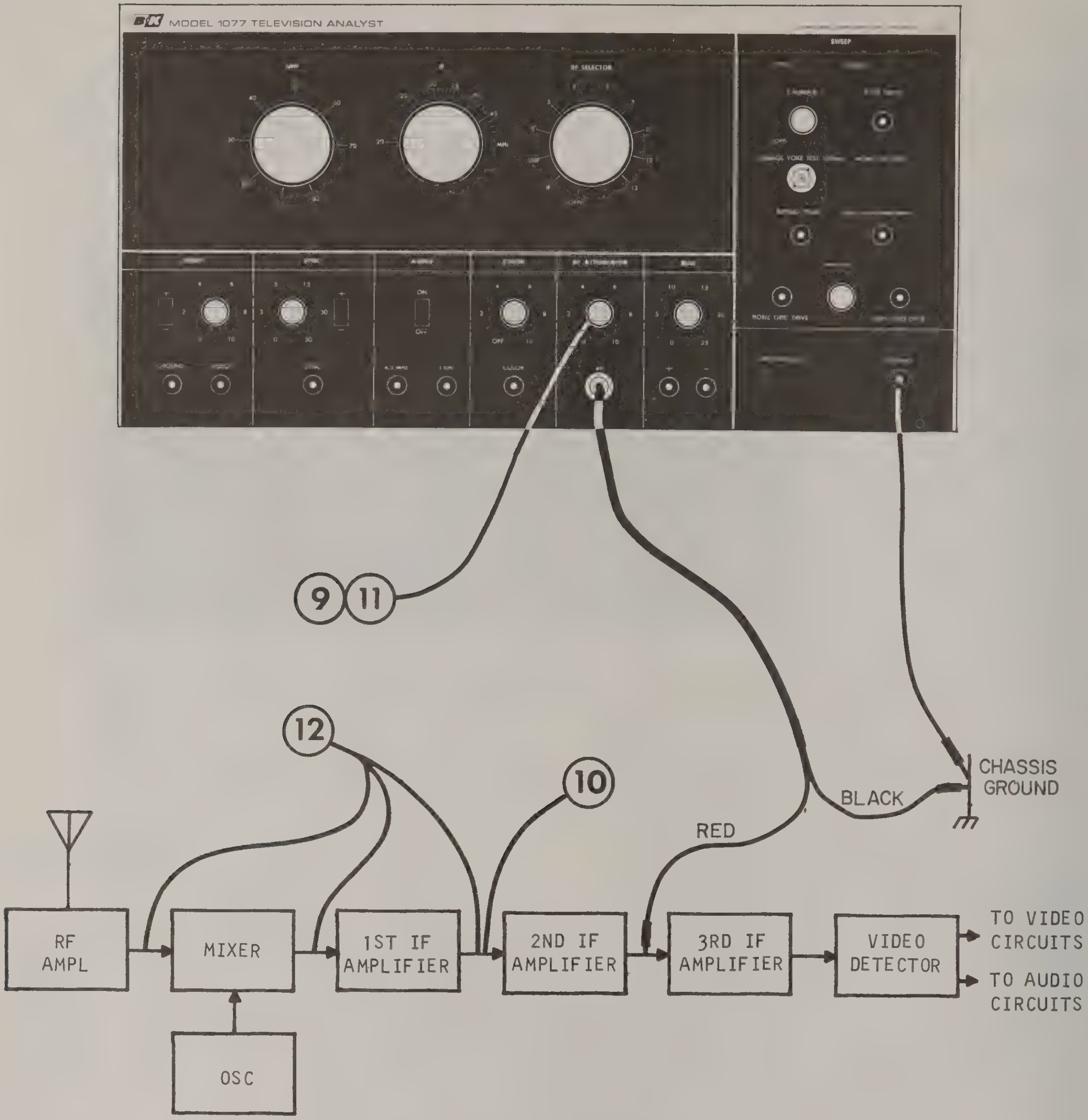


Figure 12. Making Gain Measurements with the IF Signal

D. VIDEO SIGNAL

(See Figure 13)

1. Inject a vhf signal at the antenna terminals and adjust for the best video test pattern and audio (perform steps 1 through 13 of the *VHF Signal Procedure).*
2. Remove the 3rd i-f amplifier tube. If series filaments are used in the set, connect a jumper across the filament pins. This simulates a trouble with symptoms of no video and no audio (although normal troubleshooting procedures for such a symptom would begin in the i-f section, for demonstration purposes we will check the video section).
3. Connect the black test lead from the GROUND jack to the chassis of the television receiver.
4. Connect the red test lead from the VIDEO jack to the input of the 2nd video amplifier.
5. Set the VIDEO control to 10. A test pattern, probably unsynchronized, will appear on the screen. Since video is displayed, the trouble must lie before the 2nd video amplifier.
6. If a negative picture is displayed (blacks and whites are reversed), reverse the setting of the VIDEO POLARITY switch.
7. Reduce the VIDEO control setting until a dim test pattern is displayed.
8. Move the red test lead to the input of the 1st video amplifier.
9. Reverse the setting of the VIDEO POLARITY switch. A synchronized test pattern, much darker than in step 7, should appear. This demonstrates the amplifying ability of the 1st video amplifier. It also shows that the trouble is located before the 1st video amplifier.
10. Again reduce the VIDEO control setting for a dim test pattern as obtained in step 7. Note the difference in the control setting between step 7 and step 10 for a relative indication of gain. Return the VIDEO control to the setting used in step 7.
11. Move the red test lead to the input of the video detector. The test pattern should again be displayed, showing that the trouble is located in the i-f section.
12. Remove the red test lead and replace the 3rd i-f amplifier tube. If filament pins were bridged during test remove jumper wire.

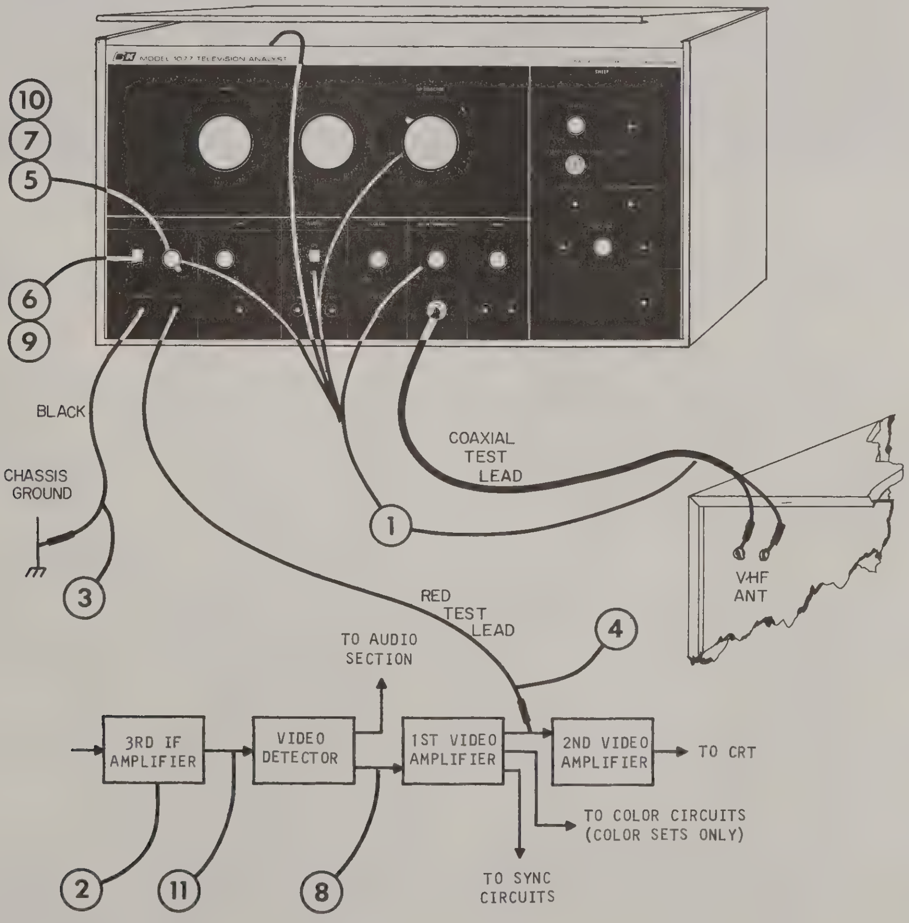


Figure 13. Connections and Control Settings for Video Signal

E. SYNC SIGNAL

(See Figures 14-15-16)

CAUTION

In transistorized television receivers, a SYNC control setting of higher than 10 volts (indicated by an asterisk*) may burn out transistors. Do not exceed this amount unless you are absolutely sure the stage normally operates at higher signal levels.

1. Leave the vhf signal injected at the antenna terminals as in step 1 of the *Video Signal* procedure.
2. Remove the sync separator tube from the television receiver. If series filaments are used, jumper the filament pins. This simulates a trouble with symptoms of no vertical or horizontal sync.
3. Set the SYNC control to 0.
4. Set the SYNC POLARITY switch to the positive position.
5. Make sure the black test lead is still connected from the GROUND jack to the chassis of the television receiver.
6. Connect the red test lead from the SYNC jack to the output of the SYNC separator.
7. Increase the SYNC control setting to the value normally used in the circuit (control is graduated in volts peak-to-peak). The required sync voltage is usually shown on the schematic diagram of the television receiver. If sync is not obtained, reverse the setting of the SYNC POLARITY switch. Vertical and horizontal synchonization will be restored, indicating that the trouble is before the output of the sync separator stage.

NOTE

Injection of the SYNC signal will restore synchronization to a television receiver only if the antenna input signal is also generated by the TELEVISION ANALYST. Do not attempt to restore sync while receiving a transmitted signal from a local channel. The SYNC signal in the TELEVISION ANALYST is entirely independent of the transmitted signal.

8. Move the red test lead to the input of the sync separator. Reverse the SYNC POLARITY switch setting. There will be loss of sync. This indicates that the trouble lies between the input and output of the sync separator stage.
9. Remove the red test lead and replace the sync separator tube. If filament pins were bridged during test remove jumper wire. Return the SYNC control setting to 0.

The sync signal can also be used as a high amplitude video test signal for injection directly into the picture tube to determine whether or not the picture tube is capable of displaying a video signal. Steps 10 through 17 give procedures for such a test on black and white television receivers.

10. Remove the final video amplifier tube. This simulates a trouble with symptoms of no video. (For normal troubleshooting techniques, we would first inject a VIDEO signal at the input of the final video amplifier. The test pattern would not be displayed. We would then follow this procedure.)
11. The black test lead is still connected from the GROUND jack to the chassis of the television receiver.
12. Connect the red test lead from the SYNC jack to the video input element of the picture tube (may be the cathode or the grid).
13. Set the SYNC control to 50.
14. Set the SYNC POLARITY switch to NEGATIVE if the signal goes to the cathode of the picture tube, to POSITIVE if it goes to the grid.
15. Turn the vertical hold control on the television receiver to roll the picture. The injected sync signal will produce black and white diagonal bars across the screen. This shows that the picture tube is capable of accepting video signals.
16. Move the red test lead to the output of the final video amplifier. The diagonal bars are still produced, which shows that all coupling devices from the final video amplifier to the picture tube are good. The trouble has been isolated to the area between the input and output of the final video amplifier.
17. Remove the red test lead and replace the final video amplifier tube. Return the SYNC control to 0 (see CAUTION at the beginning of this procedure).

Steps 18 through 27 give procedures for testing the picture tube and high amplitude video circuits of a color television receiver.

18. Turn the COLOR control to 2. The color bar pattern will be superimposed on the black and white test pattern.
19. Remove the 1st video amplifier tube. Jumper the filament pins if it is a series filament set. This simulates a trouble with symptoms of no video and no color.
20. Check that the black test lead is still connected from the GROUND jack to the chassis of the television recevier.
21. Connect the red test lead from the SYNC jack to the output of the final video amplifier.
22. Set the SYNC control to 50.
23. Turn the vertical hold control on the television receiver to roll the picture. The injected sync signal will produce black and white bars across the screen. This shows that the picture tube is capable of accepting black and white signals.

24. Move the red test lead to the output of the blue output amplifier (called B-Y output amplifier on many schematics). Blue diagonal bars will now appear on the screen, showing that the picture tube is capable of accepting blue signals.

25. Move the red test lead to the output of the green output amplifier (G-Y output amplifier). Green diagonal bars will now appear on the screen, showing that the picture tube is capable of accepting green signals.

26. Move the red test lead to the output of the red output amplifier (R-Y output amplifier). Red diagonal bars will now appear on the screen, showing that the picture tube is capable of accepting red signals.

27. Remove the red test lead, and replace the 1st video amplifier tube. Remove filament jumper wire, if used. Return the SYNC control to 0 (see the CAUTION at the beginning of this procedure). Return the COLOR control to the OFF position.

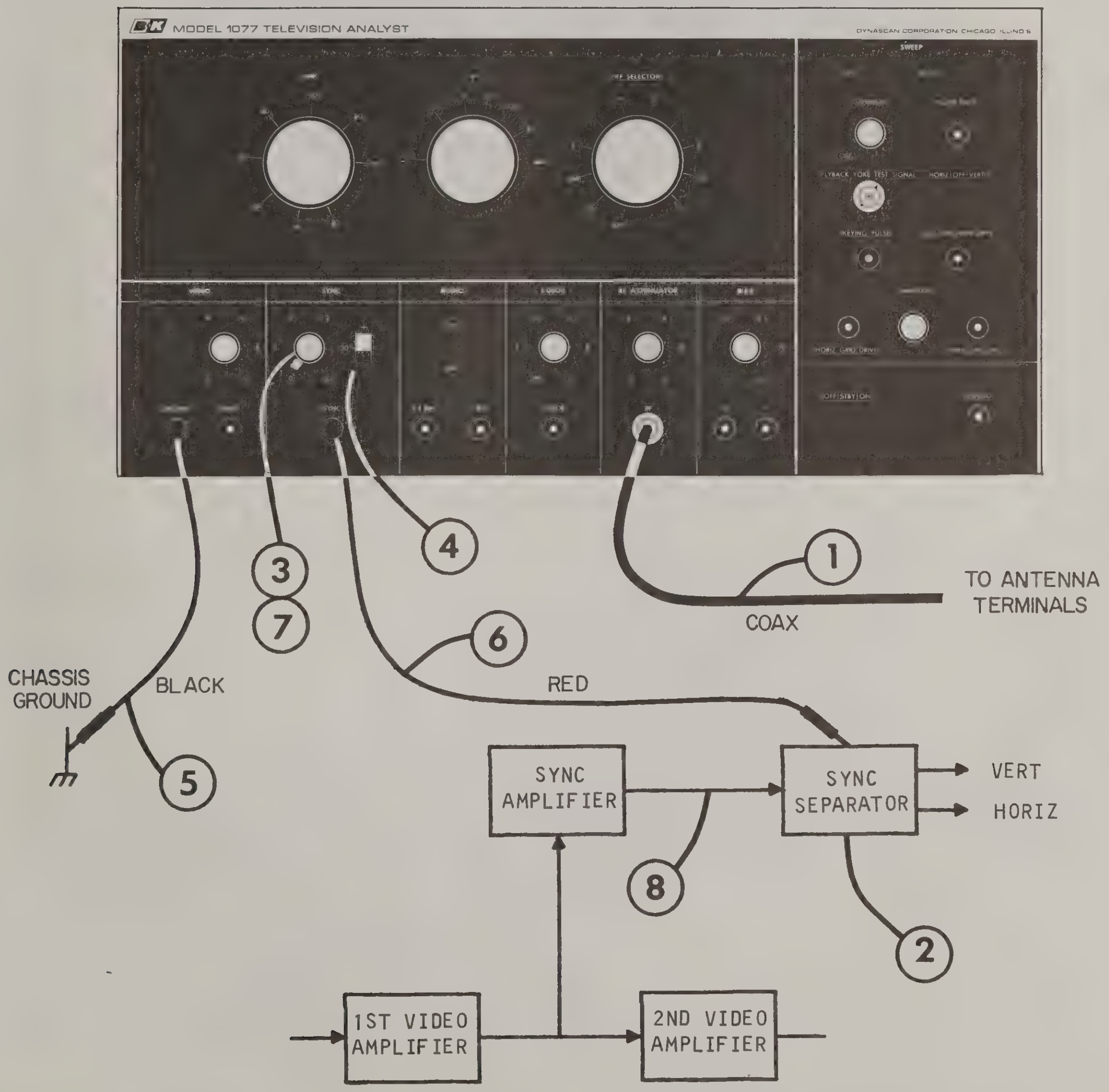


Figure 14. Connections and Control Settings for Sync Signal

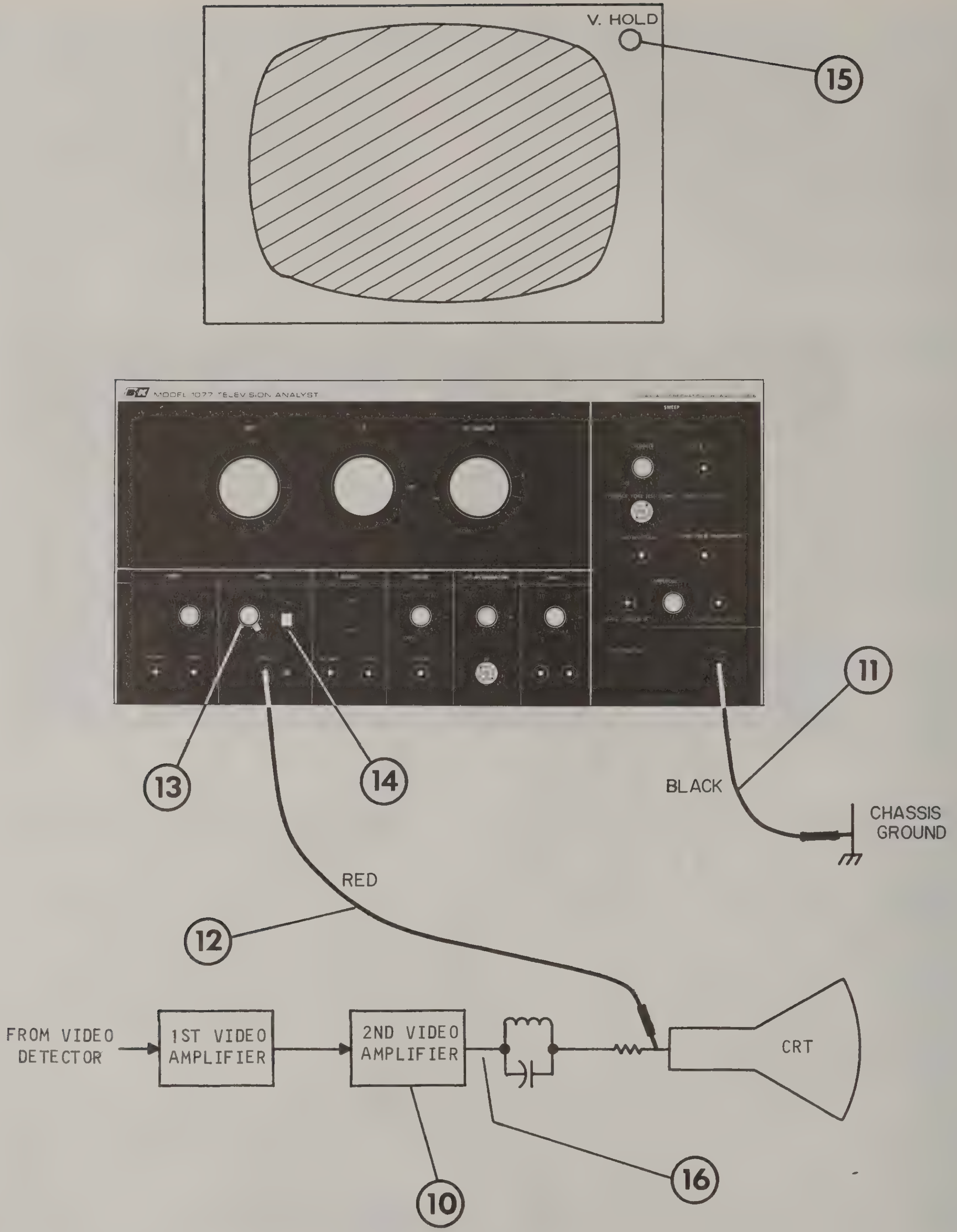


Figure 15. Sync Signal as High Amplitude Video Test Signal for Black and White Television Receiver

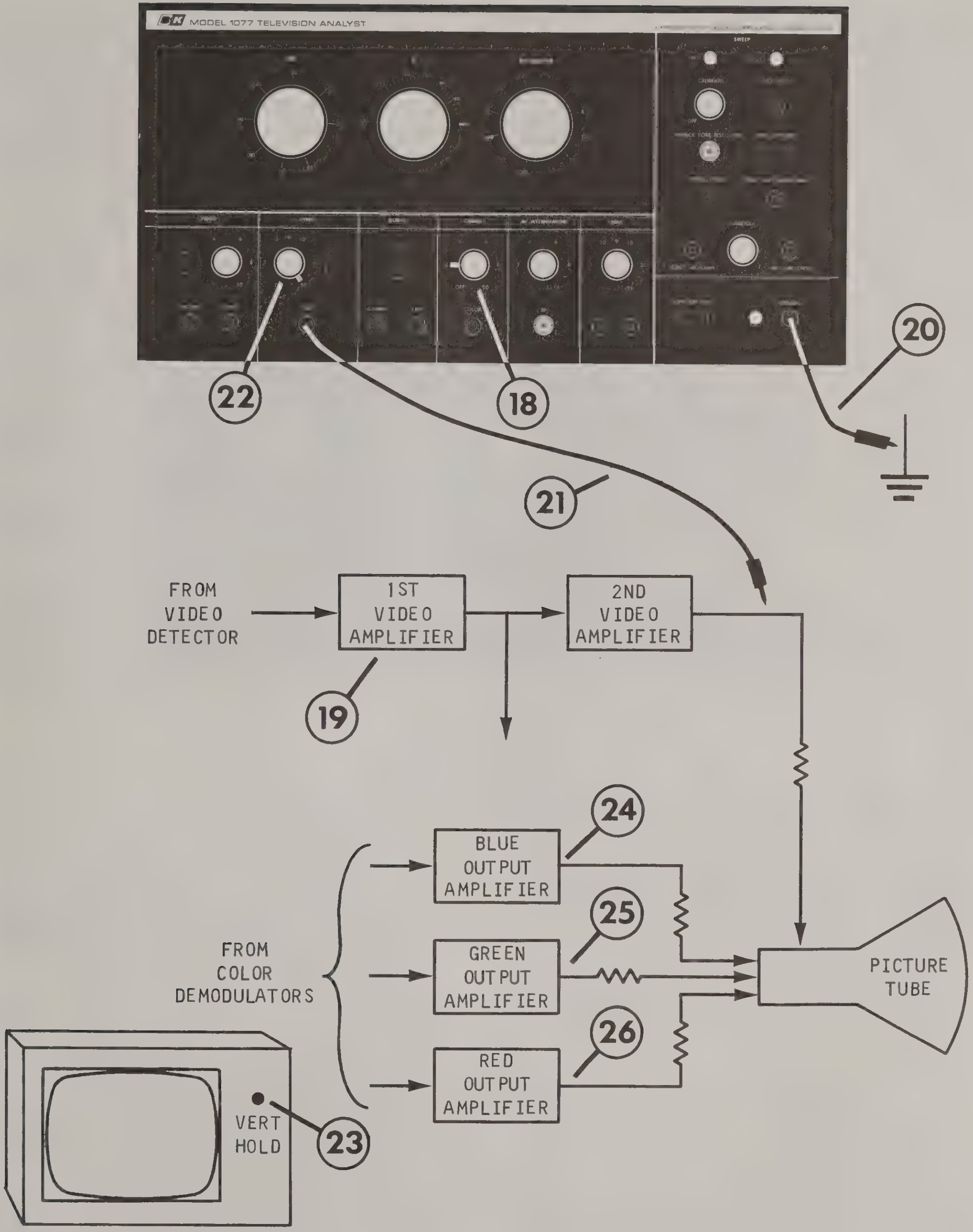


Figure 16. Sync Signal as High Amplitude Video Test Signal for Color Television Receiver

F. 4.5 MHz AND 1 KHz SIGNALS

(See Figures 17 and 18)

1. Leave the vhf signal injected at the antenna terminals as in step 1 of the *Video Signal* procedure.
2. Remove the 3rd i-f amplifier tube. Jumper the filament pins if series filaments are used. This simulates a trouble with symptoms of no video and no audio (although normal troubleshooting techniques for such a sympton would begin in the i-f section, for demonstration purposes we will check the audio section).
3. Connect the black test lead from the GROUND jack to the grounded side of the speaker voice coil. If the voice coil is ungrounded, either side will do.
4. Connect the red test lead from the 1 KHz jack to the other side of the speaker voice coil. The AUDIO ON-OFF switch may be in either position, the 1 KHz signal is still available. A low volume 1 KHz audio tone will be heard from the speaker. This listening test checks speaker operation.
5. Now, connect the black test lead from the GROUND jack to the chassis of the television receiver.
6. Connect the red test lead to the input of the audio output amplifier. The 1 KHz audio tone will be heard at a louder volume. This test checks the ability of the stage to amplify, and whether or not undue distortion is introduced by the stage.
7. Move the red test lead to the input of the 1st audio amplifier. The 1 KHz audio tone will be heard at a still louder volume. This proves that the trouble lies prior to the 1st audio amplifier.
8. Move the red test lead to the output of the audio detector. There will be less volume (unless the volume control is set at maximum) because of the attenuation of the volume control.
9. Adjust the volume control through its entire adjustment range and listen for a smooth change of loudness at the speaker. Also check for the introduction of distortion. Because the audio is heard at the speaker, the trouble is known to be located before the volume control.
10. Connect the red test lead from the 4.5 MHz jack to the input of the audio detector.
11. Set the AUDIO ON-OFF switch to ON. The 1 KHz audio tone will still be heard at the speaker, proving that the audio detector is operating properly.
12. Move the red test lead to the input of the 4.5 MHz sound i-f amplifier. A louder 1 KHz audio tone should be heard at the speaker. This test checks the amplifying ability of the stage.
13. Move the red test lead to the input of the video detector. The sound is still heard, which indicates that the trouble is located in the i-f section.
14. Remove the red test lead and replace the 3rd i-f amplifier tube. Remove filament jumper wire, if used.

G. COLOR SIGNAL

(See Figures 19 and 20)

1. Leave the vhf signal injected at the antenna terminals as in step 1 of the *Video Signal* procedure.
2. Set the COLOR control to 1 (color generator on). The color bar pattern will be superimposed on on the black and white test pattern.
3. Remove the 1st color i-f amplifier tube (this stage is also called the 1st bandpass amplifier or 1st chroma i-f amplifier on many schematics). This simulates a trouble with the symptoms of no color, but black and white reception is normal.
4. Make sure the black test lead is still connected from the GROUND jack to the chassis of the television receiver.
5. Connect the red test lead from the COLOR jack to the input of the demodulators.
6. Set the COLOR control to 10. A rainbow color pattern will be displayed (the rainbow color pattern available at the COLOR jack is not broken into color bars). A "barber pole" effect will be noticed in the color display in some sets because there is no color synchronization (the burst amplifier has no input).
7. Move the red test lead to the input of the 2nd color i-f amplifier (2nd bandpass amplifier or 2nd chroma i-f amplifier). No color will be displayed because the color killer is not biased into conduction.
8. Bias the color killer into conduction by turning the intensity control (or its equivalent in the color killer circuit) to maximum. The rainbow color pattern will again be displayed, without color sync. The colors will be brighter, which demonstrates the amplifying ability of the 2nd color i-f amplifier.
9. Reduce the COLOR control setting for light colors.
10. Move the red test lead to the output of the 1st color i-f amplifier (1st bandpass amplifier or 1st chroma i-f amplifier). A rainbow pattern with color sync should now be displayed. This demonstrates that the burst amplifier and oscillator control circuitry are operating properly.
11. Move the red lead to the input of the 1st color i-f amplifier. The rainbow pattern will disappear. The trouble is known to be located between the input and output of the 1st color i-f amplifier.
12. Remove the red test lead and replace the 1st color i-f amplifier tube. Readjust the intensity control (or its equivalent in the color killer circuit) for no color during black and white only reception.

13. Remove the burst amplifier tube. This simulates a trouble with symptoms of no color sync ("barber pole" effect).
14. Connect the red test lead from the COLOR jack to the input of the oscillator control (or automatic phase control) stage.
15. Set the COLOR control to 10. Color sync should be restored.
16. Set the COLOR control to 1.
17. Move the red test lead to the input of the burst amplifier. Color sync is lost. The trouble is isolated to the burst amplifier or the horizontal flyback pulse input path.
18. Remove the red test lead and replace the burst amplifier tube. Return the COLOR control to the OFF position.

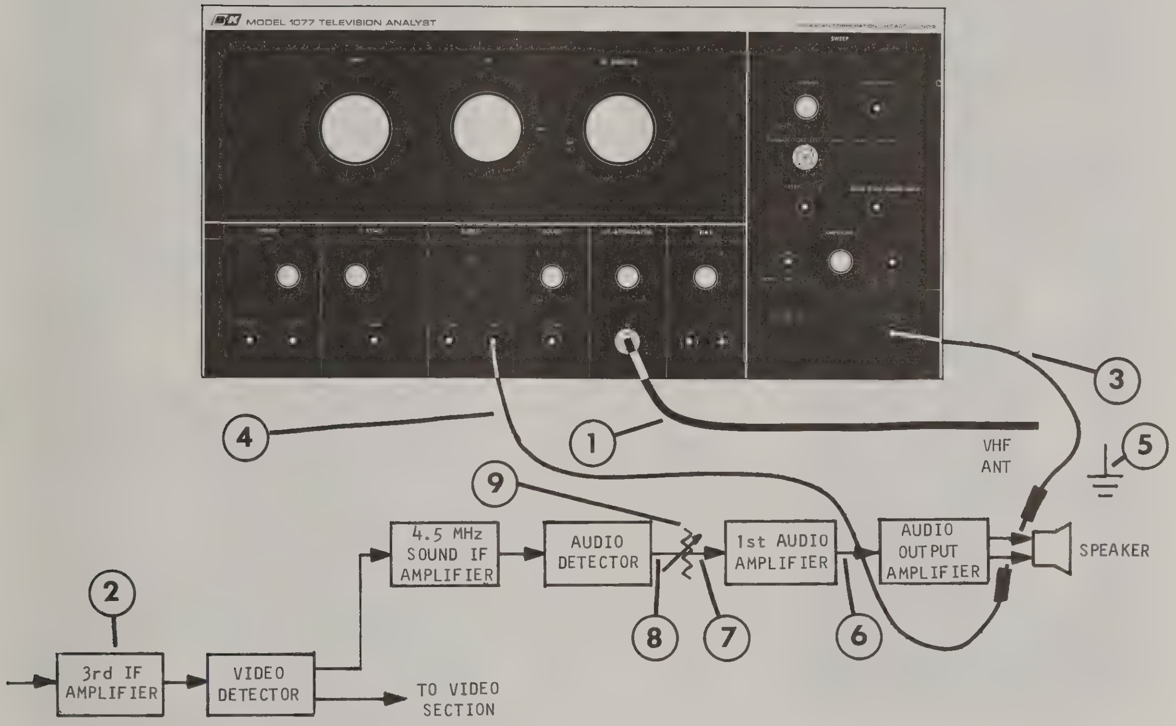


Figure 17. Connections for 1 KHz Signal

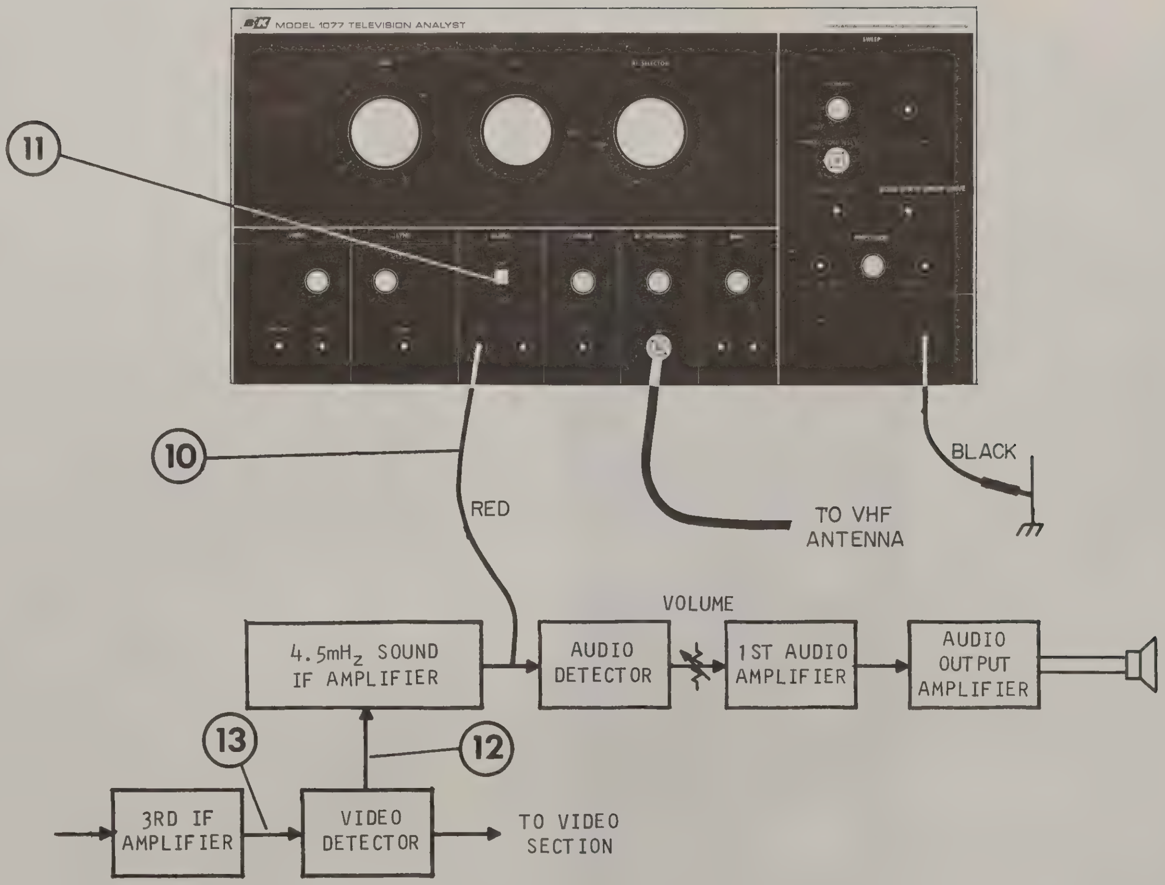


Figure 18. Connections and Control Settings for 4.5 MHz Signal

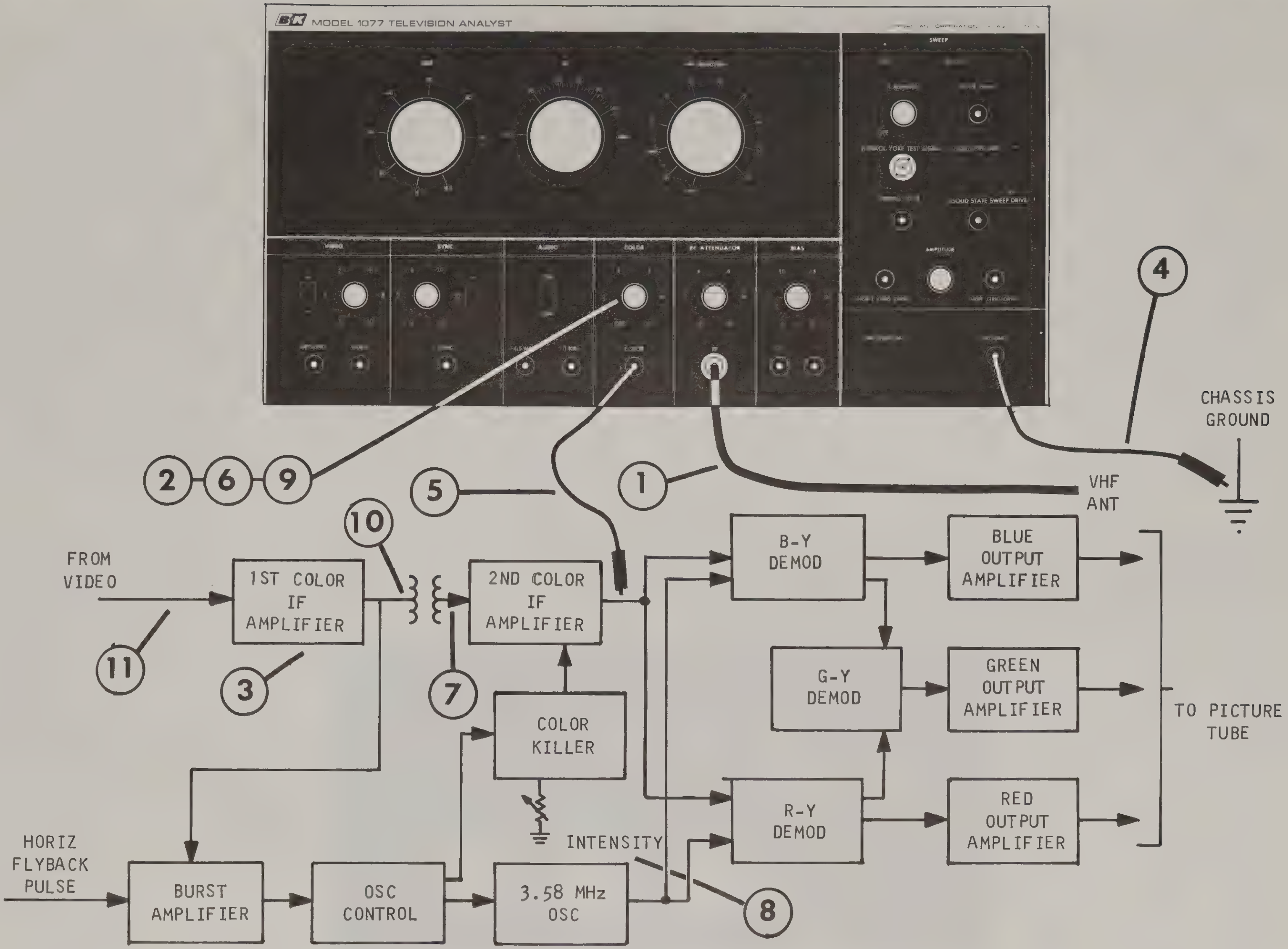


Figure 19. Connections for Color Signal in Color IF Stages

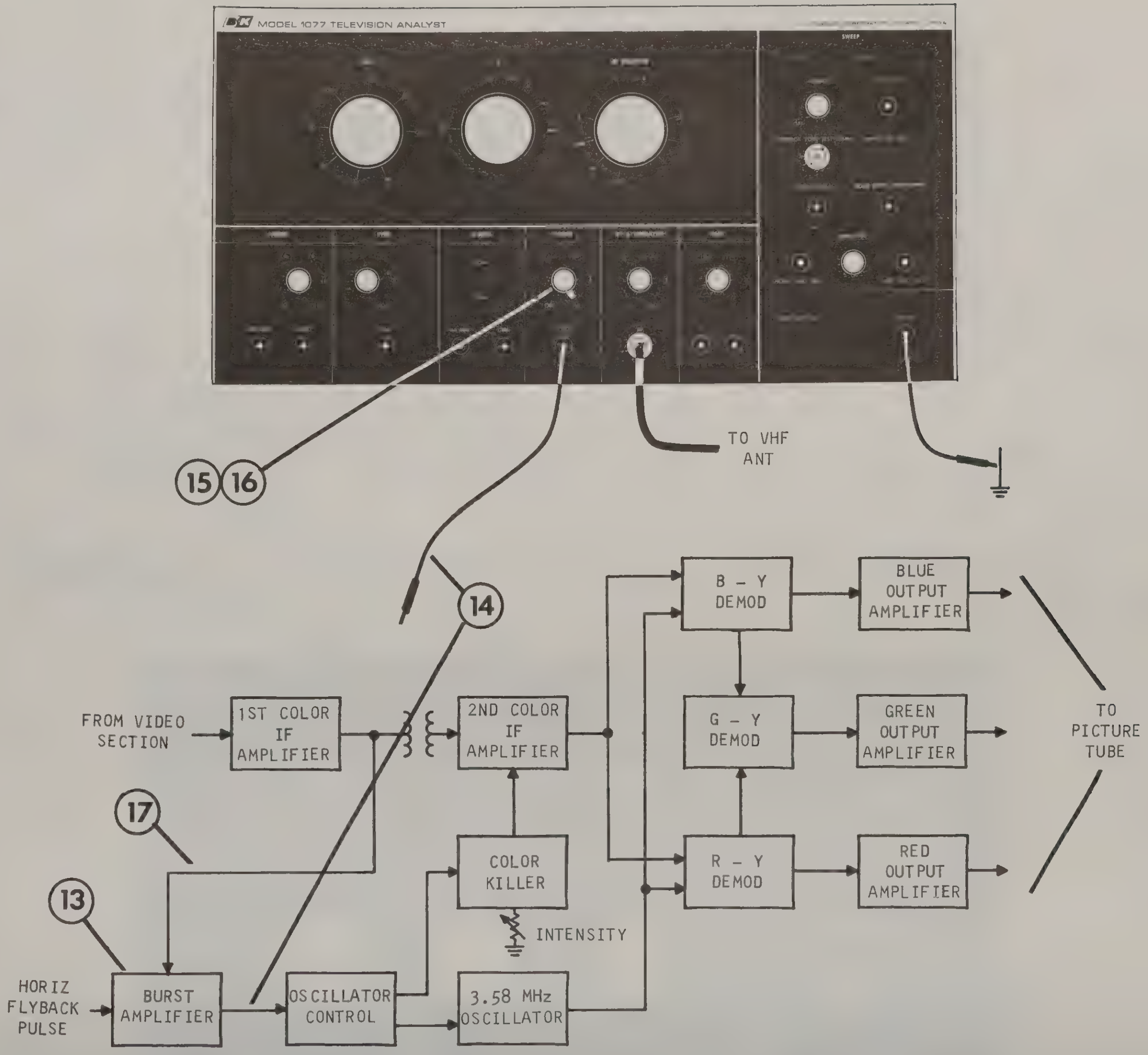


Figure 20. Connections for Color Signal in Color Sync Stages

H. BIAS VOLTAGE

(See Figues 21-22-23)

The bias voltage is a low dc voltage source, suitable for substitution in agc (automatic gain control) circuits, color oscillator control circuits, afc (automatic frequency control) circuit for horizontal oscillators, aft (automatic fine tuning) circuits, fine tuning indicator circuits, dc amplifiers and regulators, and similar dc circuits in television receivers. The low impedance bias signal "takes over" from the normal signal when it is injected. Testing of circuits is performed by adjusting the bias voltage and observing its effect.

The bias voltage is obtained from a "floating" power supply that can be referenced to any dc voltage desired, or chassis ground, by connection of test leads. Positive or negative voltage is obtained by proper lead connection.

CAUTION

> In transistorized circuits, too much bias voltage can easily and instantaneously burn out a transistor. Do not exceed the asterisk (*), which is located at 12.5 volts on the BIAS control, unless you are absolutely sure the transistor requires more voltage for normal operation. As a precaution, always return the BIAS control to 0 before changing the voltage injection point and when not being used.

Steps 1 through 7 demonstrate the use of the bias voltage to test the agc circuit of a vacuum tube television receiver.

1. Leave the vhf signal injected at the antenna terminals as in step 1 of the *Video Signal* procedure.
2. Connect the black test lead from the POSITIVE BIAS jack to the agc reference (usually chassis ground).
3. Connect the red test lead from the NEGATIVE BIAS jack to the agc line.
4. Adjust the BIAS control for the best picture on the television receiver.
5. Turn the BIAS control toward 0. Contrast will increase, then the picture will distort.
6. Turn the BIAS control toward 25. Contrast will decrease, the picture will get dim, and finally disappear.
7. Remove the test leads. Turn the BIAS control to 0.

In vacuum tube circuits, agc is always a negative voltage which is applied to the grids of the rf and i-f amplifiers to control the gain of those stages. When the voltage approaches zero, gain is very high. If a strong signal is applied in this condition, the stages will be overloaded. The signal will be clipped causing over-contrast, distortion, and loss of sync. When the voltage is increased, the gain of the stages decreases and the picture becomes weaker. Normally, at 6 to 12 volts, the picture disappears entirely because the amplifiers are completely cut off.

Steps 8 through 17 demonstrate the use of the bias voltage in an agc circuit of a transistorized television receiver.

8. Leave the vhf signal injected into the antenna terminals as in step 1 of the *Video Signal procedure.*
9. Set the BIAS control to 0.
10. For testing agc action in a PNP transistor, connect the black test lead from the POSITIVE BIAS jack to the emitter of the amplifier. This is the reference point.
11. Connect the red test lead from the NEGATIVE BIAS jack to the agc line.

CAUTION

> Always try to connect so that the resistor is located between the point of connection and the base of the transistor. There is usually only a few tenths of a volt difference of potential between the base and emitter. The resistor will absorb much of the voltage difference and permit a wider adjustment range for the BIAS control without burning out the transistor.

12. The picture will probably disappear because the transistor is cut off. Turn the BIAS control clockwise and note that the test pattern will reappear, get darker, then distort and lose sync. Do not increase the setting beyond the asterisk (*) mark.
13. Return the BIAS control setting to 0.
14. For testing agc action in an NPN transistor, connect the black test lead from the NEGATIVE BIAS jack to the emitter of the amplifier (chassis ground may be used if the emitter is connected to ground through a small resistance).
15. Connect the red test lead from the POSITIVE BIAS jack to the agc line (see the CAUTION after step 11). The picture will be blank because the transistor is cut off.
16. Increase the setting of the BIAS control and note the effect upon the display. The test pattern will reappear, get darker, then distort and lose sync. Do not increase the setting beyond the asterisk (*) mark.
17. Remove the test leads and return the BIAS control to 0.

In transistorized circuits agc is a forward bias. In PNP transistors the base is negative with respect to the emitter to produce forward bias. In NPN transistors, the base is positive with respect to the emitter. At zero potential difference, the transistor is cut off and no picture appears. As the forward bias is increased, the gain increases until overloading occurs.

Steps 18 through 23 demonstrate the use of the bias voltage in an acc (automatic color control) circuit of a color television receiver.

18. With vhf signal injected at the antenna terminals as in step 8, set the COLOR control to 1. The color bar pattern will be superimposed on the video test pattern.

19. Set the BIAS control to 0.

20. If a vacuum tube circuit, connect the black test lead from the POSITIVE BIAS jack to the chassis of the television receiver. If an NPN transistor is used as the 1st color i-f amplifier, connect the black test lead from the NEGATIVE BIAS jack to the emitter of the 1st color i-f amplifier. If a PNP transistor is used as the 1st color i-f amplifier, connect the black test lead from the POSITIVE BIAS jack to the emitter of that stage. If it is uncertain whether an NPN or PNP transistor is being used, an NPN transistor will use a positive collector source voltage and a PNP transistor will use a negative collector source voltage.

21. Connect the red test lead from the other BIAS jack to the acc line. In a vacuum tube circuit, there will be brilliant color. In transistorized circuits, there will be no color.

22. Increase the BIAS control setting and note the effect upon the color. In the vacuum tube circuit, color will decrease and cut off as the setting is increased. In the transistorized circuit, color will increase as the setting is increased. (Do not exceed the asterisk (*) mark.)

23. Remove the test leads from the BIAS jacks, return the BIAS control to 0, and return the COLOR control to OFF.

The bias signal can be used to test many other dc circuits in television receivers by similar procedures.

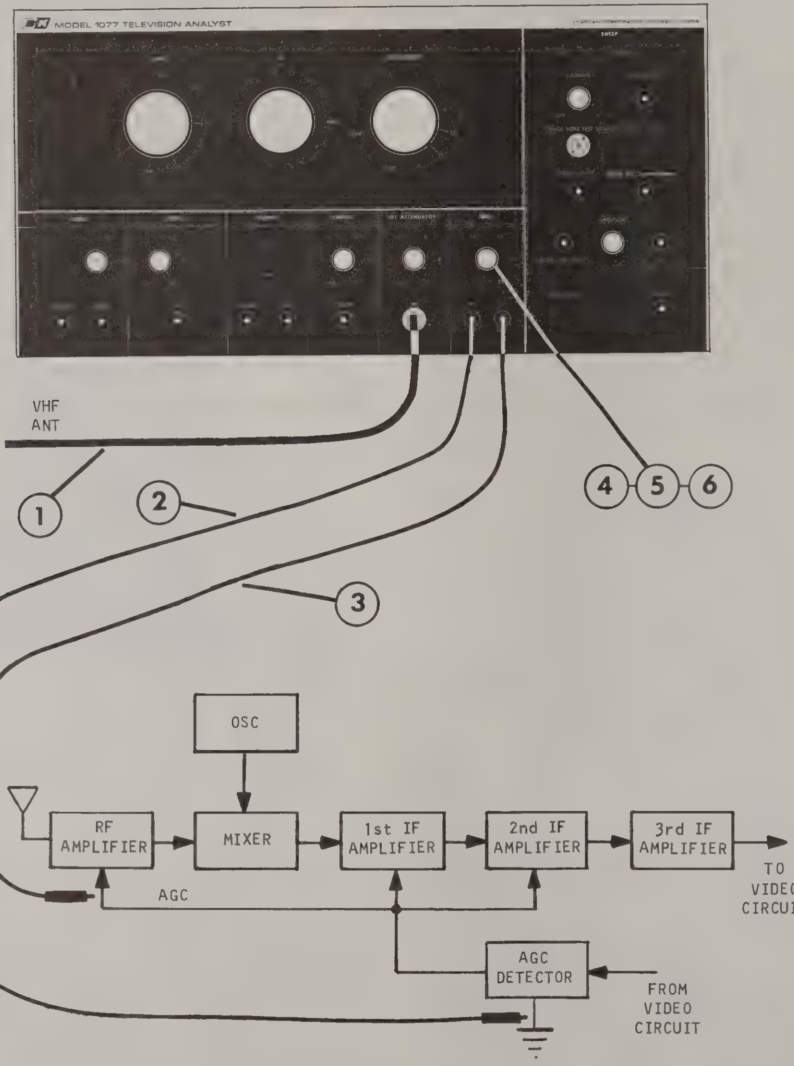
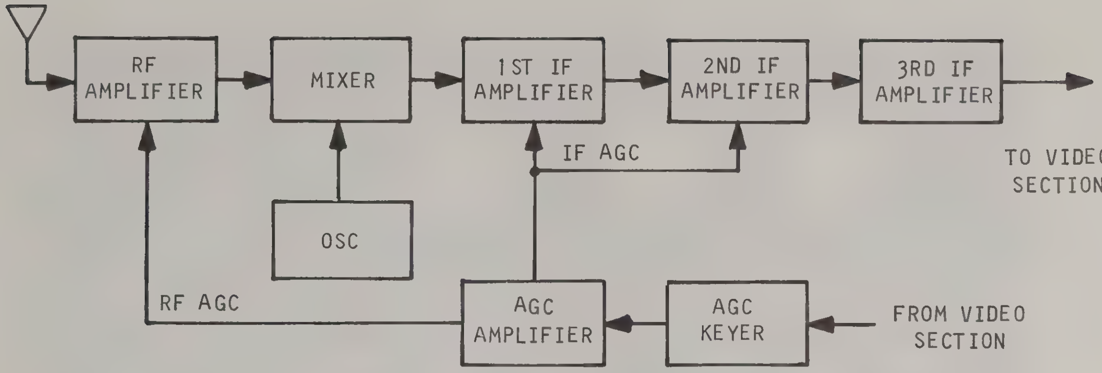


Figure 21. Bias Voltage Connections for AGC Circuit in Vacuum Tube Television Receiver



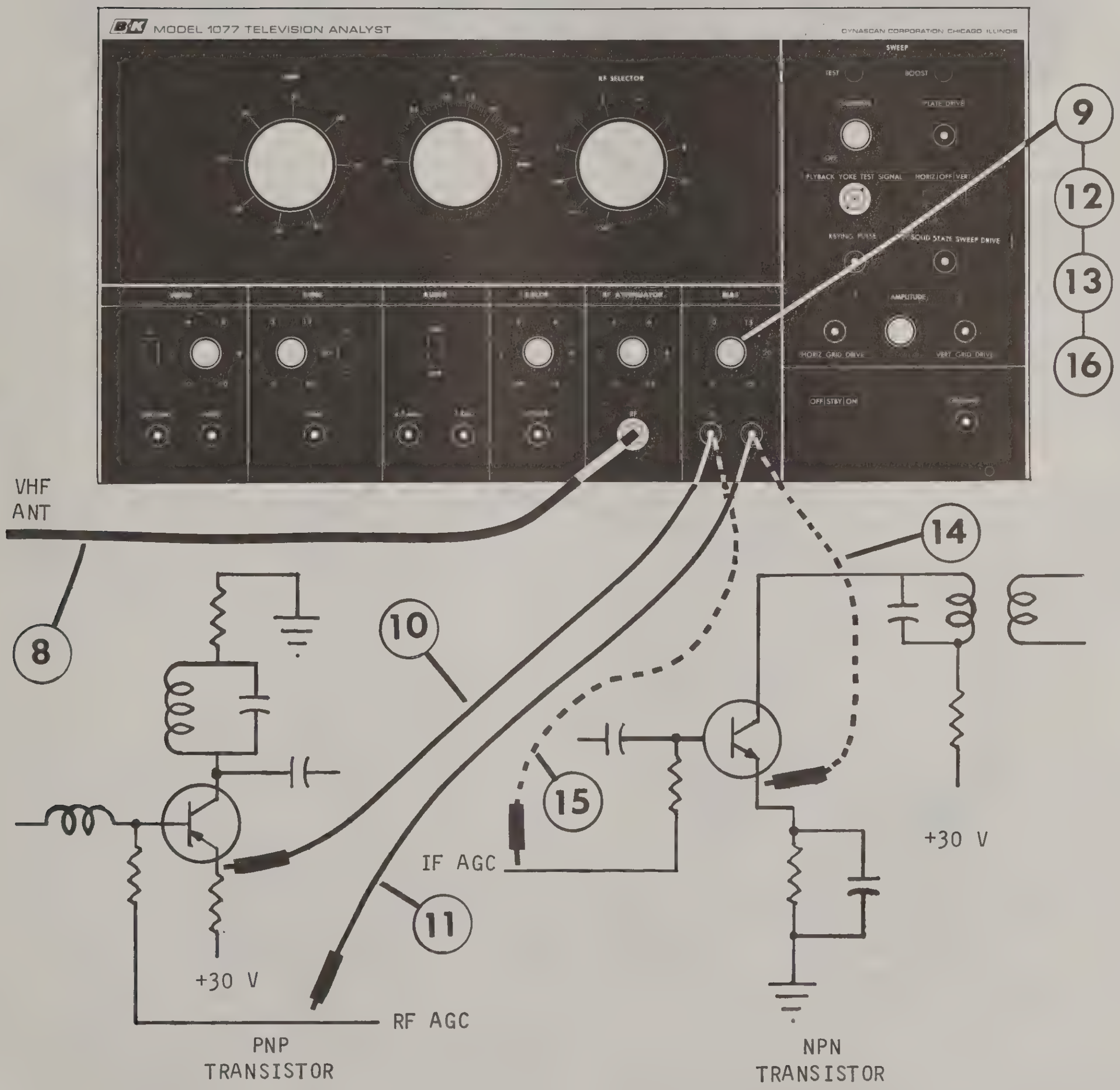


Figure 22. Bias Voltage Connections for AGC Circuit in Transistorized Television Receiver

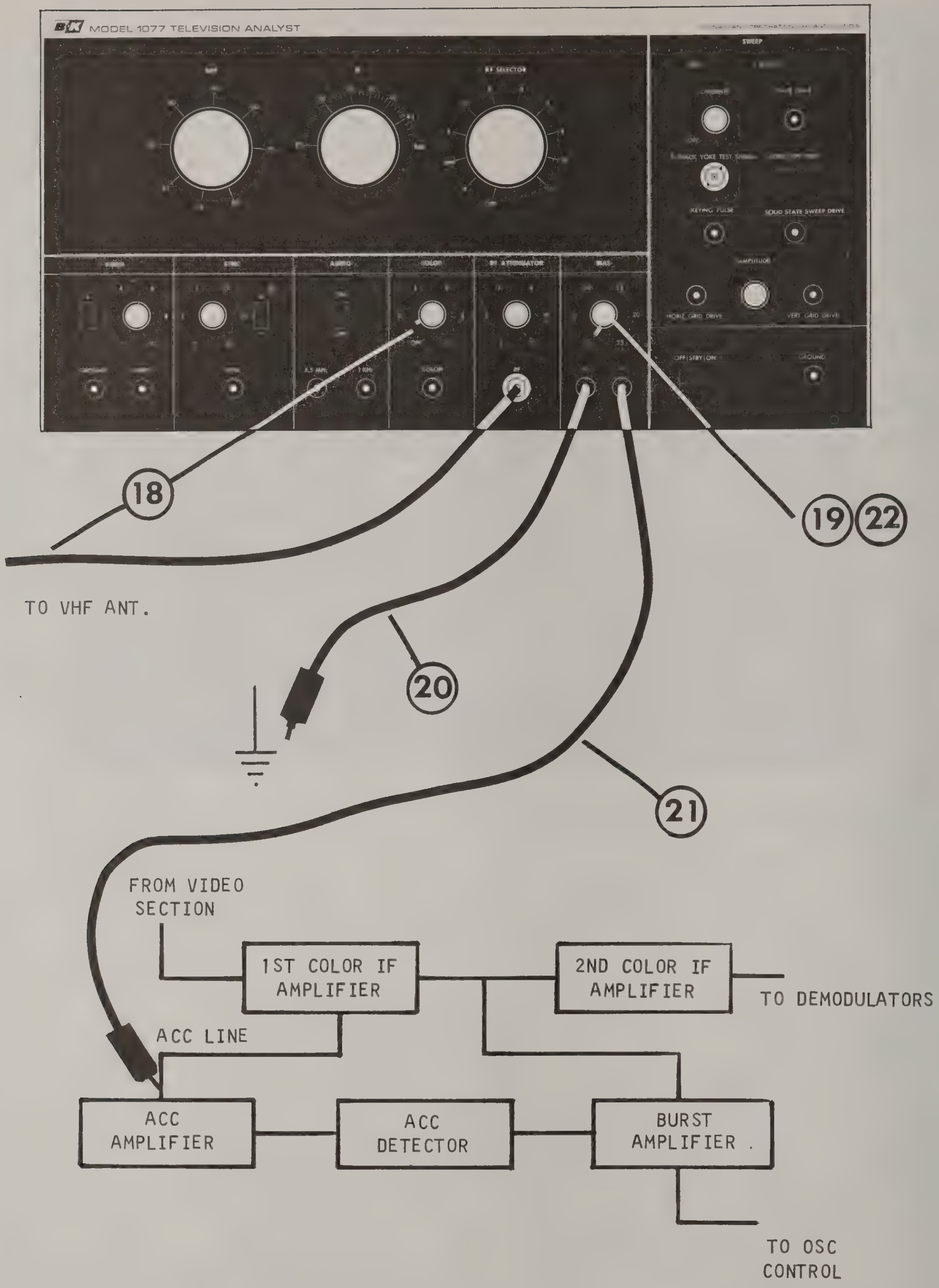


Figure 23. Bias Voltage Connection for Automatic Color Control (ACC) Circuit

I. VERTICAL GRID DRIVE SIGNAL

(See Figure 24)

Troubleshooting vertical circuits with the TELEVISION ANALYST is easily accomplished by the use of VERTICAL GRID DRIVE and VERTICAL PLATE DRIVE. The VERTICAL GRID DRIVE signal is designed to substitute for the signal driving the output amplifier. (VERTICAL PLATE DRIVE is covered in another section of this manual.)

The VERTICAL GRID DRIVE output of the ANALYST is adjustable in amplitude to better match a wider variety of receivers. When using the output, the control is normally set to half of the setting and can be adjusted if necessary to fill out the raster of the receiver under test.

1. Inject the vhf signal at the antenna terminals of the receiver.
2. Disable vertical oscillator in receiver. This can be done by removing vertical oscillator tube or shorting the grid and cathode of the oscillator.
3. Connect black ground lead from the TELEVISION ANALYST to the chassis of the television receiver.
4. Connect red lead from VERTICAL GRID DRIVE jack to the grid of the vertical output tube.
5. Set AMPLITUDE control to approximately half of the full setting while noting on the screen that vertical deflection has been restored. The deflection may not be linear but it is adequate for proving that the TELEVISION ANALYST can substitute for a missing signal.
6. Restore proper operation of vertical oscillator (reinsert tube or remove grid to cathode short).

In the above test we simulated a typical service problem (no vertical sweep). Since vertical sweep was restored when the VERTICAL GRID DRIVE pulse was applied to the grid of the vertical output tube we pinpointed the trouble to the vertical oscillator since the vertical output tube, vertical output transformer and vertical yoke windings must be functioning properly in order to restore vertical sweep with the pulse from the TELEVISION ANALYST. When servicing a television receiver if the VERTICAL GRID DRIVE pulse does not restore vertical sweep the VERTICAL PLATE DRIVE and the SOLID STATE SWEEP DRIVE will pinpoint the defective stage and, in many cases, the exact component which is defective.

VERTICAL MULTIVIBRATOR

The second vertical oscillator system which has been widely used is the multivibrator. This consists of an integrating network, a vertical multivibrator, and a vertical output tube, etc.

1. Disable the multivibrator by opening feedback path from amplifier.

   NOTE

   This multivibrator feedback path usually consists of one or two capacitors from the amplifier plate circuit, to the oscillator grid circuit.
2. Connect black lead from GROUND jack of ANALYST to chassis ground of receiver.
3. Connect red lead from VERTICAL GRID DRIVE jack to the grid of vertical output amplifier.
4. If vertical sweep occurs on the screen of the receiver the output amplifier, output transformer and vertical yoke can be assumed to be okay. The sweep may not be linear and the raster may not fill the entire screen area but it can be judged qualitatively. If sweep does occur as noted above, the trouble must be elsewhere in the system.
5. Connect lead from SOLID STATE SWEEP DRIVE jack to grid of the oscillator. (NOTE—VERTICAL GRID DRIVE jack cannot be used because it will reach the grid of the vertical amplifier with incorrect polarity.)

If the circuit from grid of the oscillator to the deflection yoke is functioning properly the image will show sweep on the screen. The sweep may not be linear but will prove the ability of the oscillator to pass the vertical pulse. This test will determine whether the defect is in the oscillator and routine troubleshooting is necessary to further isolate defective components.

VERTICAL SOLID STATE SWEEP DRIVE

(See Figure 24a)

Transistorized vertical deflection circuit troubles can be isolated by using the SOLID STATE SWEEP DRIVE output signal.

Vertical solid state sweep drive is designed to substitute for a missing drive signal to the base of the output transistor or transistors, from the driver or oscillator. Troubleshooting using the VERTICAL SOLID STATE SWEEP DRIVE output is outlined below:

1. Leave the vhf signal injected at the antenna terminals as in step 1 of the video signal procedure.
2. Disconnect power source to receiver.
3. Connect red lead from SOLID STATE SWEEP DRIVE jack to the base of the vertical output amplifier transistor. HORIZ OFF VERT switch in the VERT position.
4. Connect black lead from GROUND jack to chassis ground of receiver.
5. Set AMPLITUDE control to maximum rotation.
6. Reapply power to receiver. If vertical deflection is produced the vertical output amplifier transistor is good. Go to step 7.
7. Disconnect power source to receiver. Remove red test lead from the base of the vertical output amplifier transistor and connect to the base of the driver transistor. Set AMPLITUDE to approximately ¼ rotation.
8. Reapply power to receiver. If vertical deflection is produced the vertical driver transistor is good. Go to step 9.
9. Disconnect power source to receiver. Remove red test lead from the base of the vertical driver transistor and connect to the base of the oscillator transistor. Set AMPLITUDE to approx. ¼ rotation.

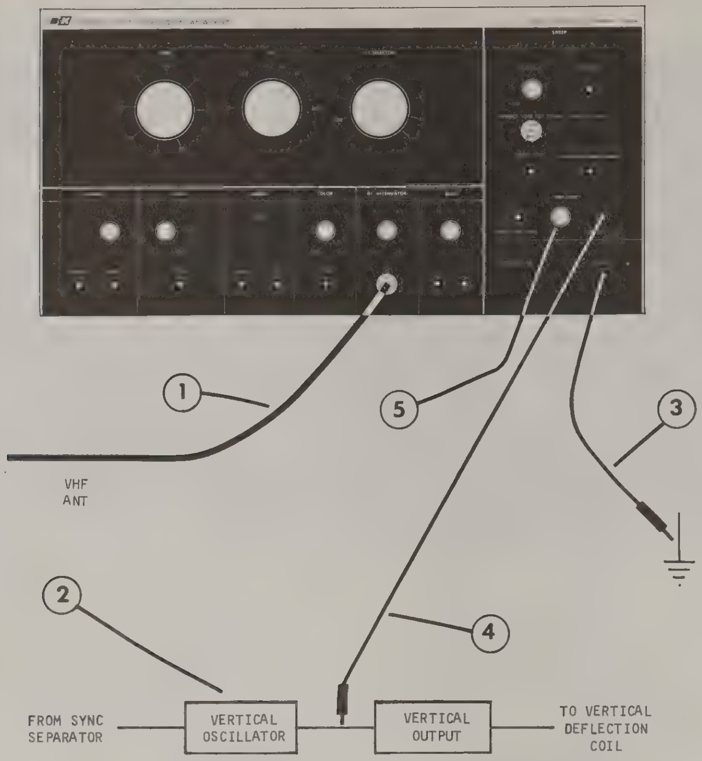


Figure 24. Connections for Vertical Grid Drive Signal

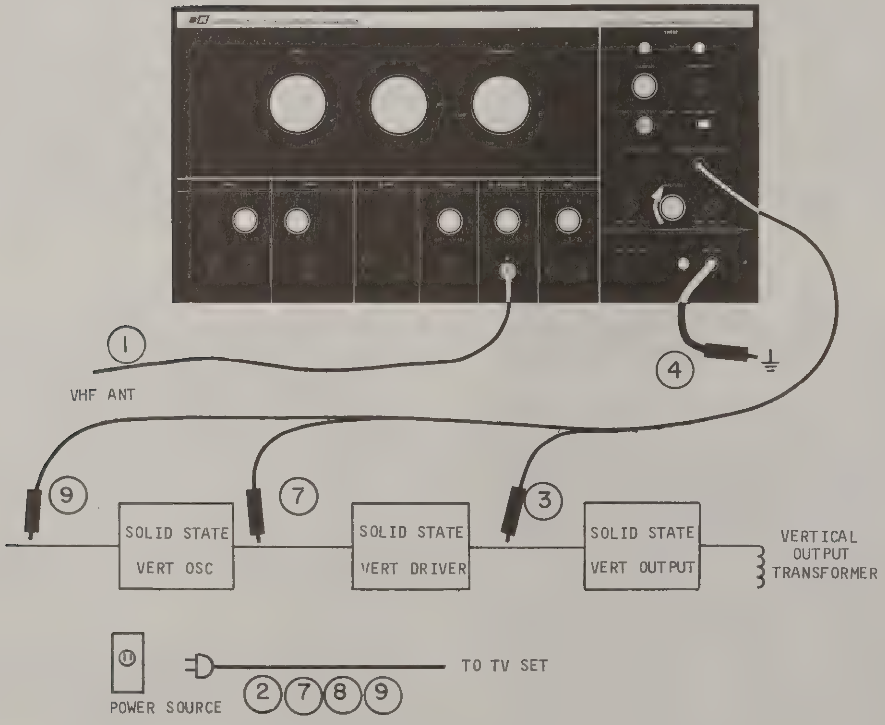


Figure 24a. Connections for Solid State Sweep Drive

J. HORIZONTAL GRID DRIVE SIGNAL

(See Figure 25)

Horizontal deflection troubles can be isolated using the HORIZ GRID DRIVE or HORIZONTAL PLATE DRIVE outputs. (Horizontal plate drive is covered in another section of this manual.)

Horizontal grid drive is designed to substitute for a missing or distorted driving signal to the horizontal output amplifier. (CAUTION — A receiver should never be operated without a proper driving signal applied to the horizontal amplifier. These amplifiers are normally operated Class "C" and excessive current drain and overheating will occur when the driving signal is absent.) Troubleshooting using the HORIZONTAL GRID DRIVE jack is outlined below:

CAUTION

Do not use the HORIZ GRID DRIVE jack signal in transistorized television receivers.

1. Leave the vhf signal injected at the antenna terminals as in step 1 of the Video Signal procedure.
2. Disconnect power source to receiver.
3. Remove the horizontal oscillator tube or otherwise disable the oscillator. This simulates a trouble with symptoms of no raster.
4. Remove plate cap from high voltage rectifier.
5. Connect high voltage indicator lamp to the insulated wire going to the plate cap disconnected in Step 4.
6. Connect red lead from HORIZONTAL GRID DRIVE jack to the grid of the horizontal amplifier.
7. Connect black lead from GROUND jack to chassis ground of receiver.
8. Reapply power to receiver. If lamp glows, it indicates the presence of high level RF pulses on the plate cap lead of the high voltage rectifier. If lamp does not glow, no RF is present and trouble has been isolated to horizontal amplifier or flyback transformer. Step 9 and 10 are not necessary and analyzing components in horizontal amplifier or flyback should determine defect.
9. Turn off power to receiver and reconnect the lead to the plate of the high voltage rectifier that was disconnected in step 2.
10. Reapply power. If the high voltage indicator remains lit, high voltage should be present and deflection should be observed on the face of the CRT (no deflection on the CRT with the high voltage indicator lamp lit indicates a defective high voltage rectifier circuit).

If application of a driving pulse to the horizontal amplifier resulted in restoring operation to the receiver, the trouble must lie in the horizontal oscillator circuit.

Troubles such as oscillator off frequency, dead or weak oscillator may be isolated in this manner.

Horizontal multivibrator circuits may also be tested using the horizontal grid drive. The procedure is similar to troubleshooting vertical multivibrators. Each section of the horizontal multivibrator can be tested separately to determine which section is at fault.

Multivibrators must have the ability to amplify. Therefore, if signal injection is used through the multivibrator, a specific point of failure can be determined.

HORIZONTAL SOLID STATE SWEEP DRIVE

(See Figure 25a)

Transistorized horizontal deflection circuit troubles can be isolated by using the SOLID STATE SWEEP DRIVE output signal.

Horizontal solid state sweep drive is designed to substitute for a missing drive signal to the base of the output transistor or transistors, from the drivers, buffer or oscillator. Troubleshooting using the horizontal solid state sweep drive output is outlined below:

1. Leave the vhf signal injected at the antenna terminals as in step 1 of the Video Signal procedure.
2. Disconnect power source to receiver.
3. Remove plate cap from high voltage rectifier.
4. Connect high voltage indicator lamp to the insulated wire going to the plate cap disconnected in Step 3.
5. Connect red lead from SOLID STATE SWEEP DRIVE jack to the base of the horizontal output amplifier transistor. HORIZ OFF VERT switch in the HORIZ position. AMPLITUDE control should be set to ¾ of full rotation.
6. Connect black lead from GROUND jack to chassis ground of receiver.
7. Reapply power to receiver. If lamp glows, it indicates the presence of high level RF pulses on the plate cap lead of the high voltage rectifier. If lamp does not glow, no RF is present and trouble has been isolated to horizontal amplifier or flyback transformer. Step 8 and 9 are not necessary and analyzing components in horizontal amplifier or flyback should determine defect.
8. Turn off power to receiver and reconnect the lead to the plate of the high voltage rectifier that was disconnected in step 3.
9. Reapply power. If the high voltage indicator remains lit, high voltage should be present and deflection should be observed on the face of the CRT (no deflection on the CRT with the high voltage indicator lamp lit indicates a defective high voltage rectifier circuit).

If application of a driving pulse to the horizontal amplifier resulted in restoring operation to the receiver, the trouble must lie in the horizontal oscillator, buffer or driver.

Repeat steps 1 through 9 for the driver, buffer and oscillator using a slightly lower setting of the AMPLITUDE control for each stage preceding the output amplifier.

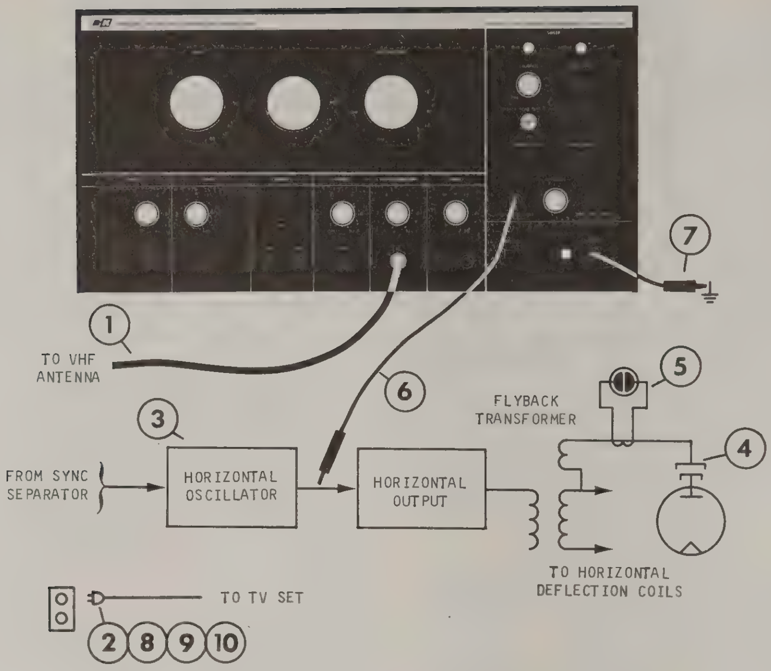


Figure 25. Connections for Horizontal Grid Drive Signal

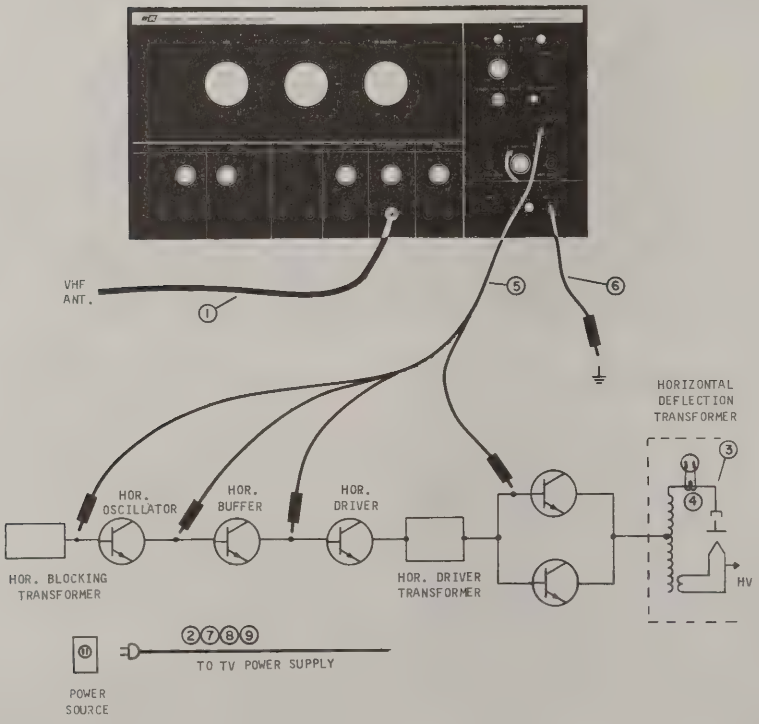


Figure 25a. Connections for Horizontal Solid State Sweep Drive

K. VERTICAL PLATE DRIVE SIGNAL

(See Figure 26)

1. Leave the vhf signal injected at the antenna as in step 1 of the *Video Signal* procedure.
2. Remove power from the television receiver.

   WARNING

   Disconnect power before making connections. High voltage is present in this circuit.
3. Remove the vertical output amplifier tube. This simulates a trouble with symptoms of no vertical deflection.
4. Connect the black test lead from the GROUND jack to the chassis of the television receiver.
5. Connect the red test lead from the PLATE DRIVE jack to the plate pin of the tube socket from which the vertical output amplifier tube was removed.
6. Place the HORIZ-OFF-VERT switch in the VERT position.
7. Apply power to the television receiver. Vertical sweep will be provided. It may be non-linear, but its operation proves that the vertical output transformer and deflection coils are operating. The AMPLITUDE control adjusts the size of the pattern.
8. Remove power from the receiver, remove the red test lead, replace the vertical output amplifier tube, and return the HORIZ-OFF-VERT switch to OFF.

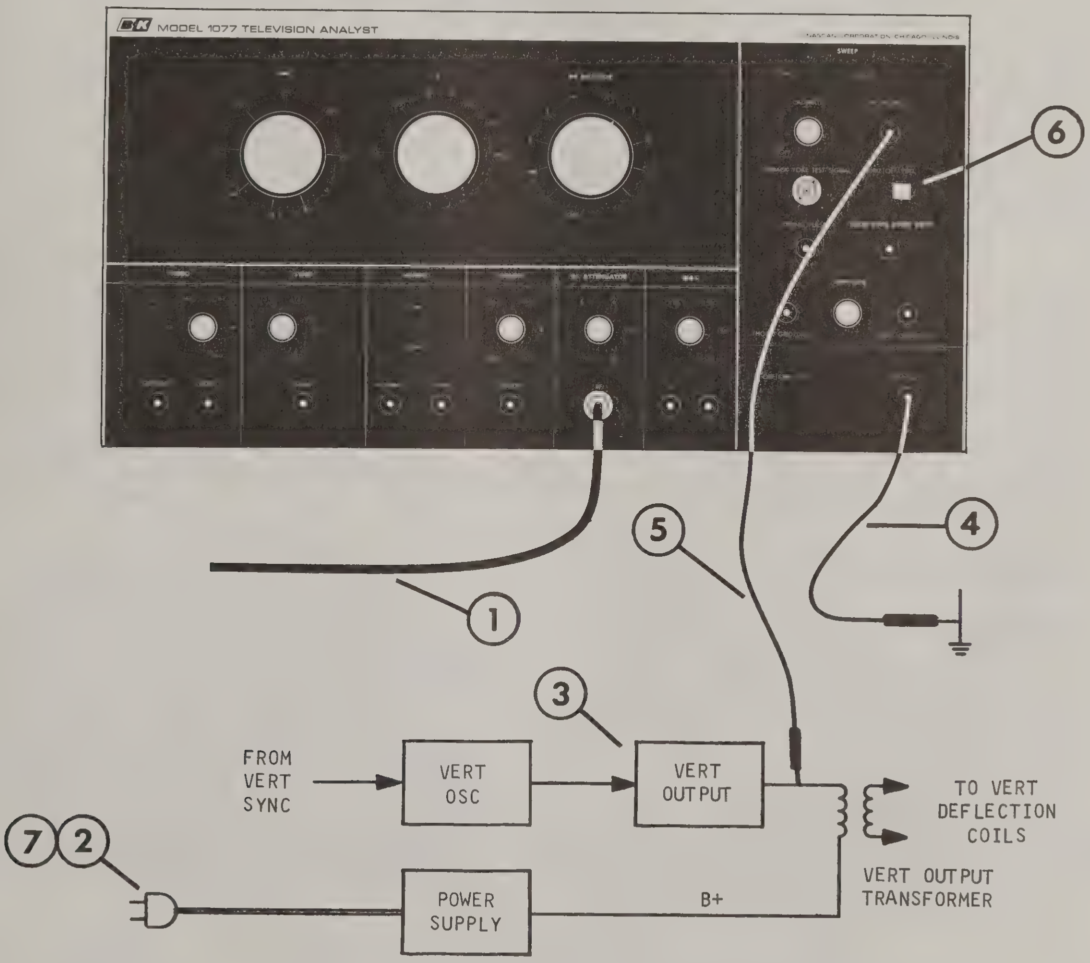


Figure 26. Connections for Vertical Plate Drive Signal

L. HORIZONTAL PLATE DRIVE SIGNAL AND BOOST INDICATOR

(See Figure 27)

WARNING

Disconnect power before making connections. High voltage is present in this circuit.

1. Leave the vhf signal injected at the antenna as in step 1 of the *Video Signal* procedure.
2. Remove power from the television receiver.
3. Remove the plate cap from the horizontal output amplifier tube. This simulates a trouble with symptoms of no raster. If the tube does not have a plate cap, disconnect the plate lead from the tube socket.
4. Connect the black test lead from the GROUND jack to the chassis of the television receiver.
5. Connect the red test lead from the PLATE DRIVE jack to the plate lead that was removed from the horizontal output amplifier.
6. Place the HORIZ-OFF-VERT switch in the HORIZ position.
7. Apply power to the television receiver. Horizontal sweep will be restored.
8. The BOOST INDICATOR lamp will light showing that B+ boost voltage is being developed.
9. Remove power from the television receiver, remove the red test lead, replace the plate connection to the horizontal output amplifier tube, and return the HORIZ-OFF-VERT switch to the OFF position.

M. KEYING PULSE

(See Figure 28)

Some circuits in a TV receiver are biased to cut off and operate only during the retrace period. These circuits (AGC—Blanker—Burst amp., etc.) are turned on by a pulse from the flyback transformer. This pulse has enough amplitude to overcome the cut off bias and allow the circuits to operate. The KEYING PULSE provides a pulse (approximately 400V peak to peak) that may be used to test these circuits.

AGC

1. Leave the vhf signal injected at the antenna terminals as in step 1 of the *Video Signal* procedure.
2. Remove power from the television receiver.
3. Unsolder the connection from the flyback transformer to the agc keyer stage.
4. Reapply power; the picture will have too much contrast and be overloaded.
5. Connect the black test lead from the GROUND jack to the chassis of the television receiver.
6. Connect the red test lead from the KEYING PULSE jack to the plate of the agc keyer tube. The picture will return to normal.
7. Remove the red test lead, and replace the connection from the flyback transformer to the agc keyer stage.

OTHER USES OF KEYING PULSE

The KEYING PULSE can be used to test other circuits requiring a high level pulse with occurs at flyback. Color killer, burst amplifier, and blanker circuits in the chroma section of a color receiver are typical examples.

1. Leave the vhf signal injected at the antenna terminals as in step 1 of the *Video Signal* procedure.
2. Remove power from the television receiver.
3. Unsolder the connection from flyback transformer to the circuit to be tested.
4. Connect the black test lead from the GROUND jack to the chassis of the television receiver.
5. Connect red lead from KEYING PULSE to the point from which flyback connection was disconnected in step 3 above. If normal operation of the receiver is restored by substituting signal from keying pulse jack, you can assume the defect is not caused by lack of keying pulse and routine voltage and resistance tests should then be made to locate defective parts or circuit.

CAUTION

Do not use the KEYING PULSE in transistorized circuits. The peak voltage (400 volts) far exceeds the breakdown voltage for most transistor circuits. Determine the normal operating pulse voltage from the schematic diagram for the television receiver. Often the SYNC pulse can be used in solid state circuits and tube type circuits requiring less than 400V peak to peak. Most blanking circuits for example use a pulse of 65V peak to peak. This may be tested with the SYNC pulse output from the Analyst. Use the procedure as outlined above except that the SYNC pulse is used instead of the KEYING PULSE.

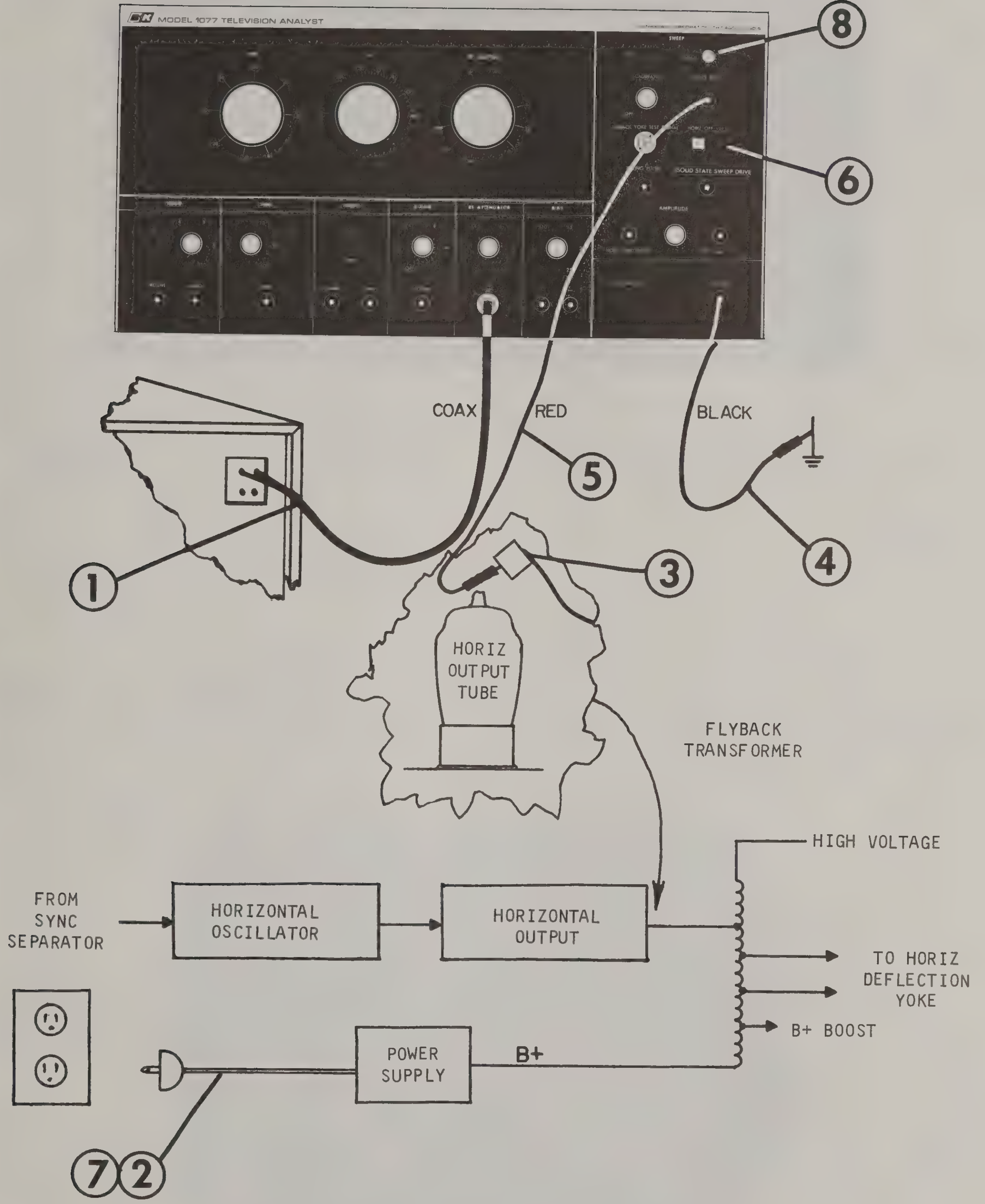


Figure 27. Connections for Horizontal Plate Drive Signal and B+ Boost Indicator

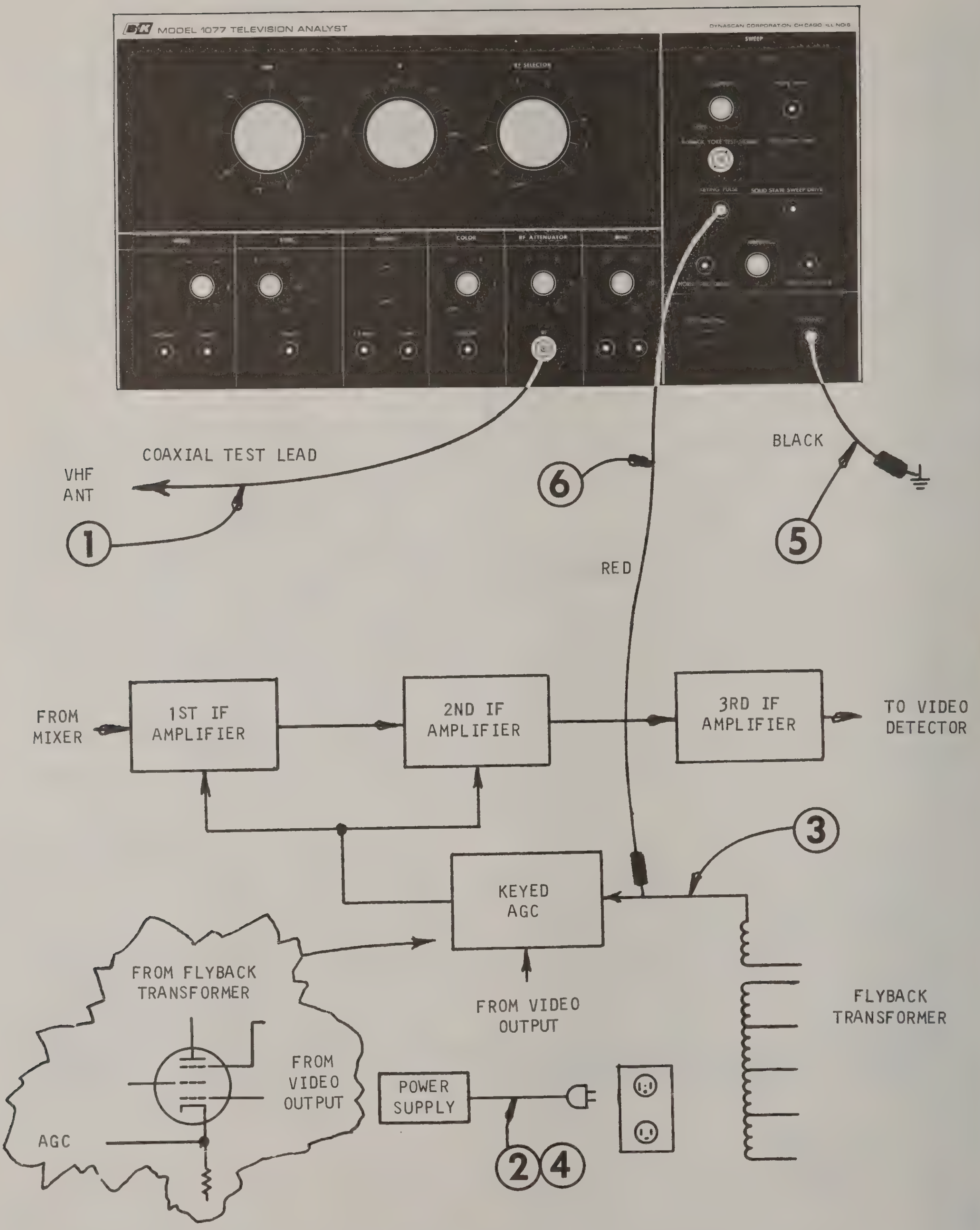


Figure 28. Connections for AGC Keying Pulse

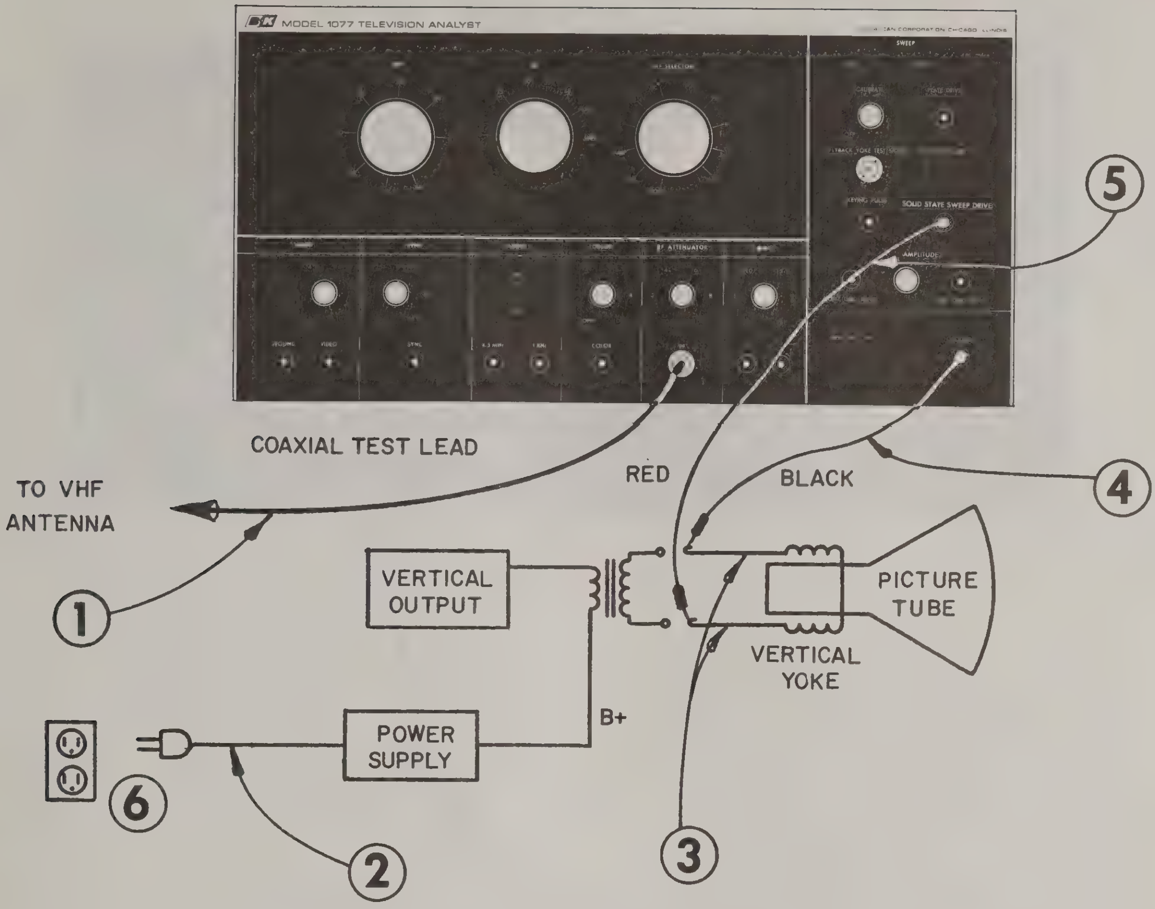


Figure 29. Connections for Vertical Yoke Test Signal

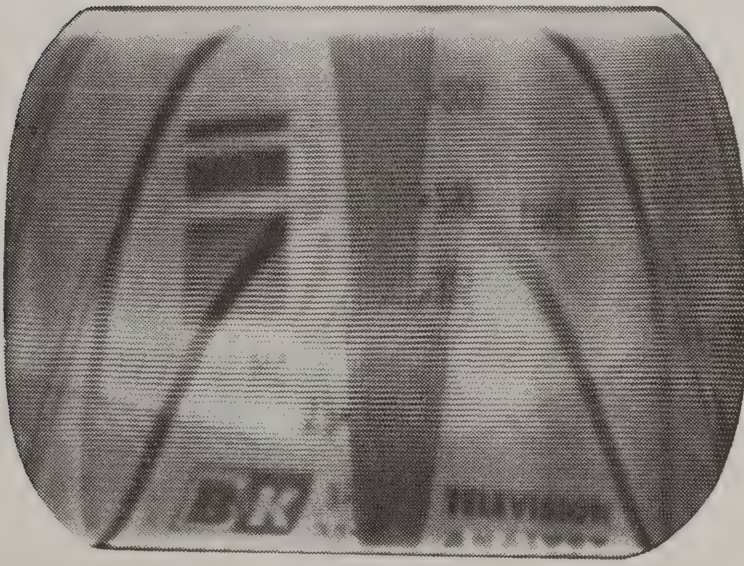


Figure 30. Display Developed Using Vertical Yoke Test Signal

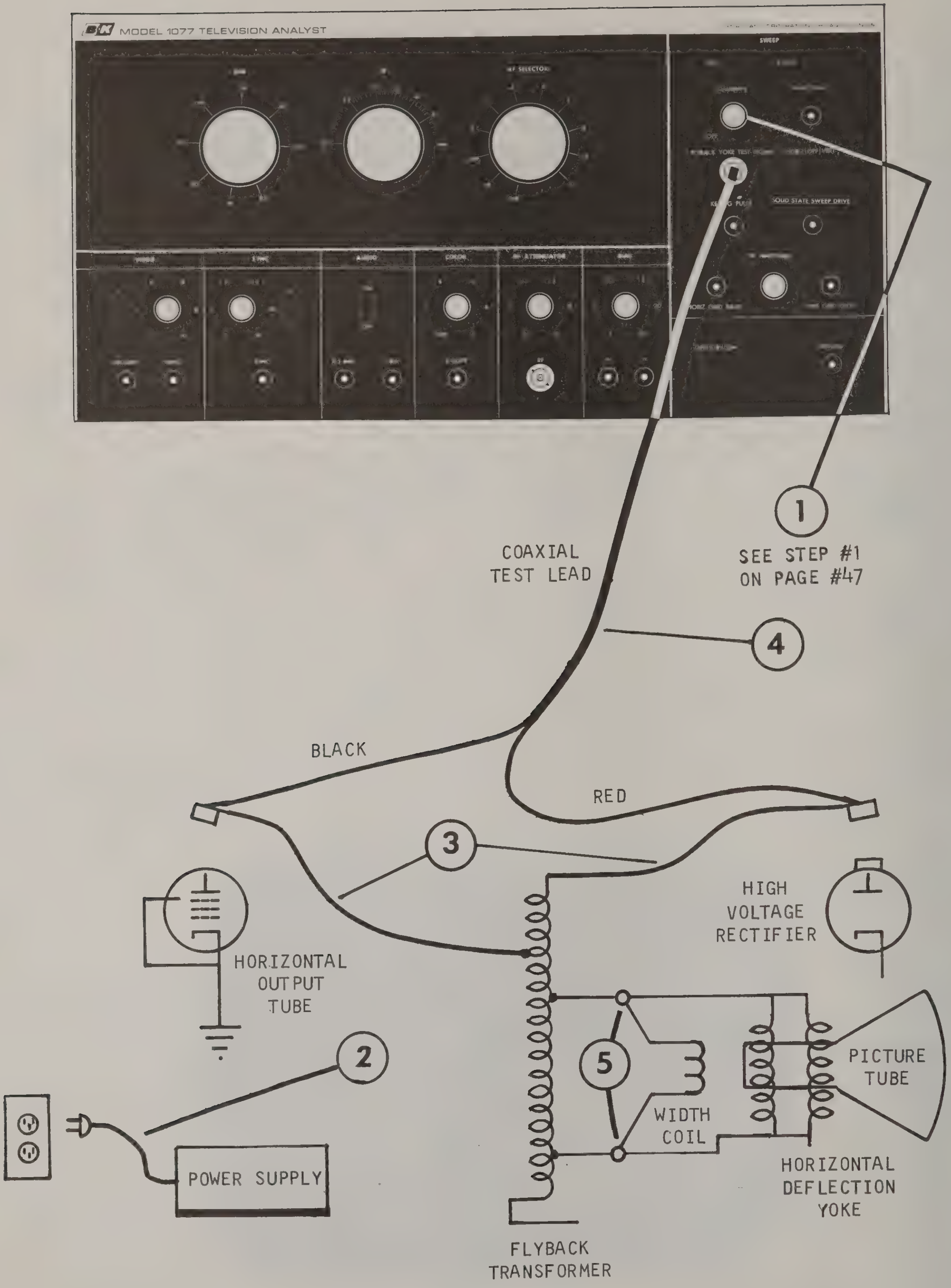


Figure 31. Connections for Flyback Yoke Test Signal

N. VERTICAL YOKE TEST

(See Figures 29 and 30)

1. Leave the vhf signal injected at the antenna terminals as in step 1 of the *Video Signal* procedure.
2. Remove power from the television receiver.
3. Disconnect the leads from the vertical deflection yoke.
4. Connect the black test lead from the GROUND jack to one side of the vertical deflection yoke.
5. Connect the red test lead from the SOLID STATE SWEEP DRIVE jack to the other side of the vertical deflection yoke.
6. Turn the television receiver on.
7. Place the HORIZ-OFF-VERT switch in the VERT position.
8. Adjust the AMPLITUDE control for full sweep.
9. Remove power, disconnect the test leads, and reconnect the vertical yoke.

O. FLYBACK YOKE TEST SIGNAL

(See Figure 31)

Do not use this yoke test on vertical windings. Erroneous results will be obtained.

1. With the coaxial test cable connected to the FLYBACK YOKE TEST signal jack, turn the CALIBRATE control clockwise until the TEST INDICATOR lamp comes on; then turn slowly counterclockwise to the point where the TEST INDICATOR lamp barely goes off.
2. Remove power from the television receiver.
3. Disconnect the plate caps from the horizontal output tube and the high voltage rectifier.
4. Clip the black lead of the coaxial test cable to the cap that was removed from the horizontal output tube. Clip the red lead of the coaxial test cable to the cap that was removed from the high voltage rectifier.

If the TEST INDICATOR lamp glows, this indicates a short in the windings of the flyback transformer (or the horizontal deflection yoke which is connected across the flyback transformer; on some television receivers a width coil is also connected in parallel with the flyback transformer). *It will respond to as little as one shorted turn.*

5. If the TEST INDICATOR lamp glows during the test, disconnect the horizontal deflection yoke and width coil, one at a time, and repeat the test until the faulty component is located.
6. Remove the coaxial test lead and reconnect all circuits in the television receiver. Return the CALIBRATE control to off.

NOTE:

Modern deflection systems such as those used in color sets have many loads connected to the flyback transformer which may appear as "shorted turns". When using this test signal make connections as indicated in the Instruction Manual, disconnecting the leads to the rectifier tube or solid state rectifier, and amplifier tube or solid state driver. If the set has a rectifier tube or if the C.R.T. heater is driven from a winding on the flyback transformer these must be disconnected or unplugged since the loading will appear as a shorted turn. Convergence assemblies must always be disconnected during this test as well. Proceed with the test and if shorted turns are indicated, completely disconnect the transformer from the circuit and test again.

P. HIGH VOLTAGE TEST

(See Figure 32)

1. Remove power from the television receiver.
2. Clip the high voltage probe around the insulated wire that connects to the plate cap of the high voltage rectifier.
3. Remove the plate cap from the high voltage rectifier tube.
4. Reapply power to the television receiver.
5. If high voltage rf is present, the bulb in the high voltage probe will light. This proves that the high voltage is being developed properly in the flyback transformer.
6. Again remove power from the television receiver.
7. Replace the plate cap on the high voltage rectifier tube.
8. Reapply power. If the bulb is still lit, the entire high voltage circuit is good. If the bulb goes out, there is a short circuit in the dc output path of the rectifier. The short kills the high voltage rf oscillations.
9. Remove power from television receiver and remove the high voltage probe.

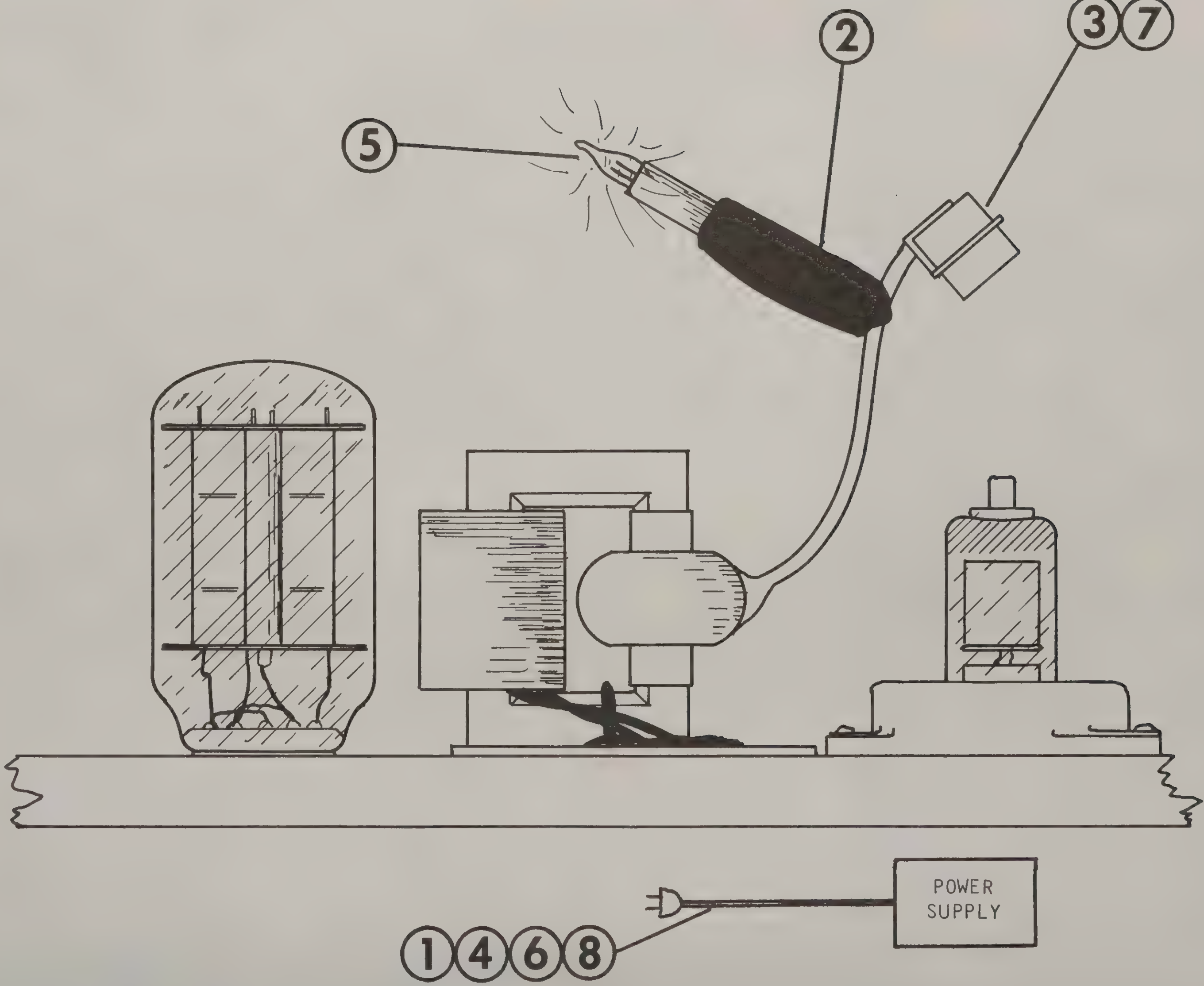


Figure 32. Connections for High Voltage Test

TROUBLESHOOTING TECHNIQUES

A. BASIC SIGNAL SUBSTITUTION TECHNIQUES

(See Figures 33-34-35)

The signal substitution method of troubleshooting uses the signals generated by the TELEVISION ANALYST and injects them into a television receiver. The signal substitutes for the missing signal in the malfunctioning television receiver and restores operation. The signal is usually injected nearest the picture tube, then moved one stage at a time toward the antenna until signal injection does not restore operation. The defective stage has then been located.

Every television receiver has many different types of signals present at various stages throughout the set. The TELEVISION ANALYST generates 15 types of signals, most of them adjustable in amplitude, which permits substitution of the correct signal at almost any point in any television receiver. Figure 33 shows a block diagram of a typical black and white television receiver. It illustrates 23 typical signal injection points that may be used for locating a defective stage. Figure 35 illustrates a transistorized color television receiver with 45 typical signal injection points. To successfully use the TELEVISION ANALYST, you need only to know which signal to inject at each stage and the approximate amplitude of the signal. The steps in the *Troubleshooting Procedures* section of this manual give you the specific information for such signal injection. It is permissible to simultaneously use as many outputs as necessary to restore proper operation.

The basic procedure for troubleshooting by the signal substitution method may be summarized as follows:

1. First, the symptoms are analyzed to determine the group of stages that should be checked. A complete section of this manual is devoted to analyzing symptoms.

2. A signal of the proper type is injected into the suspected stage furthest from the antenna.

3. If proper operation is restored, a signal is injected into the next stage nearer the antenna. The proper type and level of signal must be injected to simulate normal operating conditions in each stage. This stage-by-stage injection is continued until a point is found where signal injection does not restore proper operation. The defective stage is now located.

4. Inject the signal at each component that is in series with the signal path (such as coupling capacitors and transformers) until the trouble has been isolated to as small an area as possible.

6. If the specific defective component has not already been determined, a minimum number of voltage and resistance checks will locate the trouble.

When you become more familiar with the instrument, you may wish to skip stages and check a complete section at a time. The TELEVISION ANALYST then becomes even more of a time saver and a more profitable servicing instrument.

To further explain the signal substitution technique, a typical example follows (refer to Figure 33):

1. A vhf signal is injected at the antenna terminals (point 9) and the symptoms are analyzed. Symptoms: no video, audio normal, raster normal. These symptoms tell us that the horizontal and high voltage sections are operating because raster is present. Since sound is normal, we can assume that all stages from the antenna to the video detector are operating. The stages that require checking are the picture tube, 2nd video amplifier, and 1st video amplifier.

2. A high amplitude sync signal is injected directly into the picture tube (point 1) and video bars are displayed on the screen. This proves that the picture tube is good.

3. Maximum video signal is injected at the input to the 2nd video amplifier (point 2). A test pattern is displayed on the screen. This proves that the 2nd video amplifier is good.

The video signal amplitude is reduced until the picture is barely visible. (The next step will inject the signal at the 1st video amplifier. If it amplifies normally, it should provide a much stronger picture when the signal is applied to it).

Inject the low level video signal at the input of the 1st video amplifier (point 3). The test pattern disappears entirely. We have found the defective stage. The trouble lies between the input of the 1st video amplifier and the input of the 2nd video amplifier.

4. Refer to Figure 34 which is a schematic diagram of the defective stage. Inject maximum video signal at point 2A. The test pattern is again displayed. This proves that the coupling capacitor is good.

Inject maximum video signal at the plate of the 1st video amplifier (point 2B). The test pattern is still displayed. This means that the amplifier tube VI is not providing an output signal. The tube has already been tested and found to be good.

5. Voltage measurements show plate voltage normal, but screen voltage is zero. A resistance check shows that C4 is shorted.

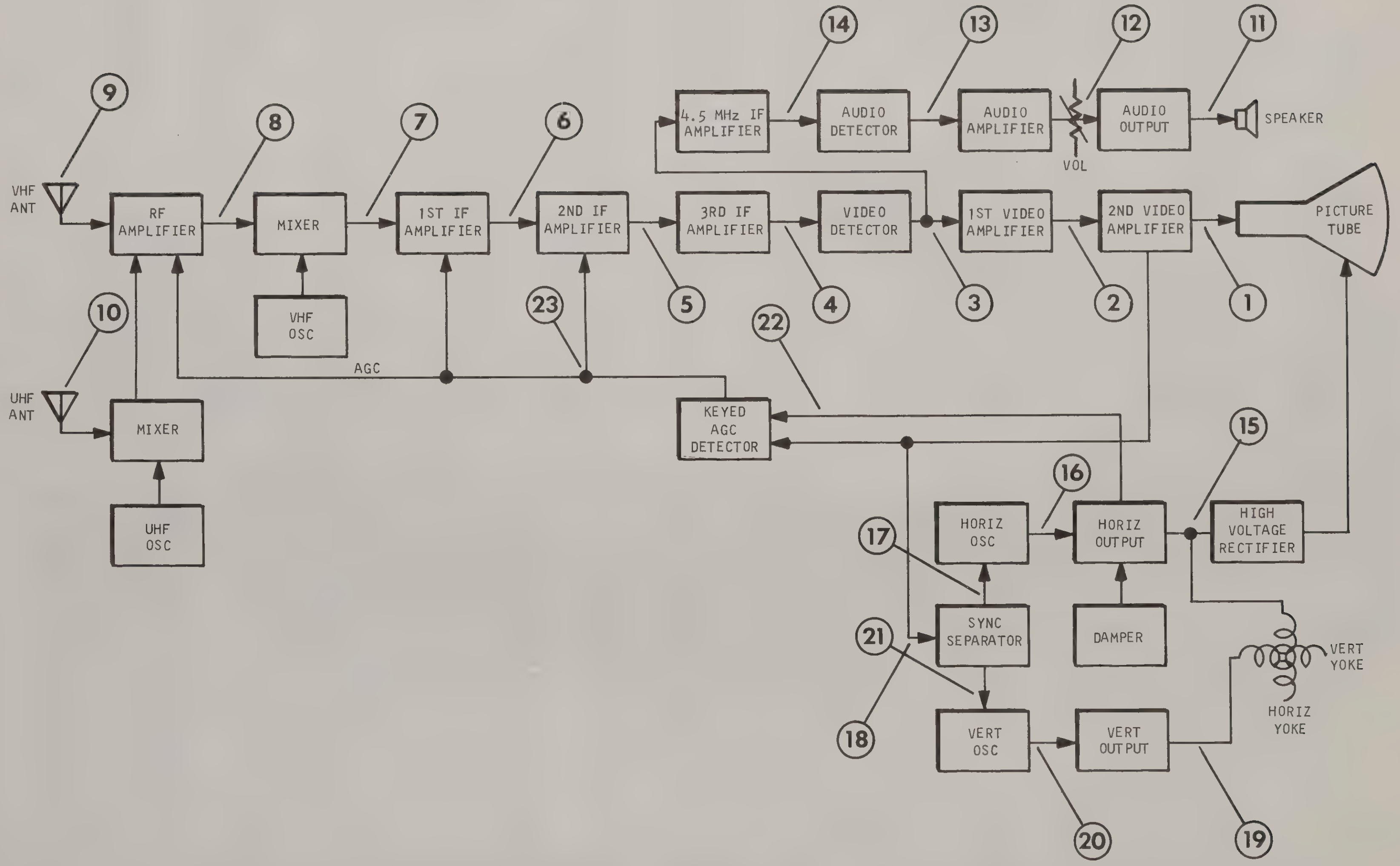


Figure 33. Block Diagram of Typical Vacuum Tube Black and White Television Receiver

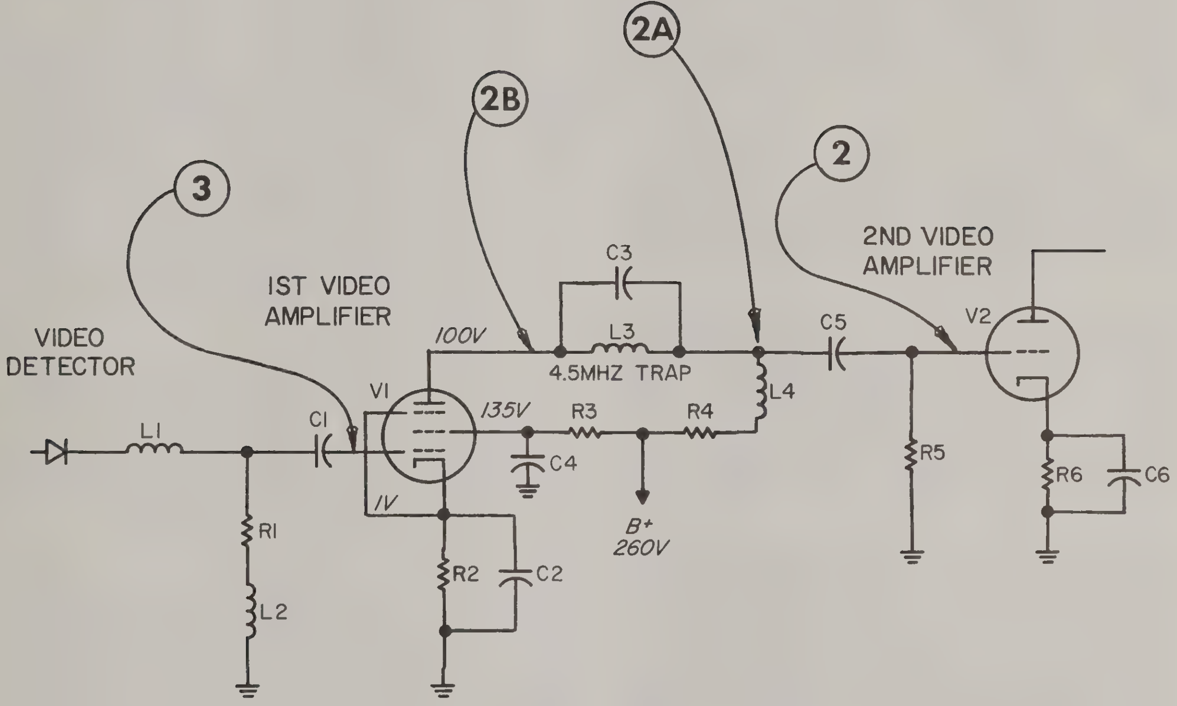


Figure 34. Schematic Diagram of Typical Video Amplifier

B. TROUBLESHOOTING TRANSISTOR STAGES

(See Figures 35-36-37)

Transistor stages are essentially equivalent to vacuum tube stages. The emitter is equivalent to the cathode, the base is equivalent to the control grid, and the collector is equivalent to the plate. One difference which should be noted that directly concerns signal substitution troubleshooting techniques is the different biasing. Vacuum tubes always use negative bias on the control grid. Transistors use forward bias; that is, the base is positive in respect to the emitter in NPN transistors and negative in PNP transistors. The biasing voltage for transistors, as well as the collector voltage, is normally much lower than in equivalent vacuum tube stages. Transistor stages usually have low input and output impedances compared to vacuum tubes. The TELEVISION ANALYST uses low impedance signals which are well suited for injection into transistorized or vacuum tube circuits.

Unlike vacuum tube circuits, transistors cannot normally be plucked from a socket and a new one substituted. A complete stage-by-stage troubleshooting procedure is required. The TELEVISION ANALYST and the signal substitution technique are essential for efficient troubleshooting of transistor stages.

There are some precautions that must be taken for transistor stages that are not necessary in vacuum tube circuits. First, transistors are very vulnerable to transient voltage spikes and shorts. Careless or random use of test probes will undoubtedly cause trouble in this respect. The safest method for preventing transient voltages from damaging transistors is to turn off the television receiver while making and removing test connections.

A short can easily burn out a transistor. Transistors are especially vulnerable to a short between the base and the collector. Since the components are usually very small compared to equivalent vacuum tube circuit components, care must be exercised to prevent shorting transistor leads to other circuits with the tip of the test probe. Use the miniature tips when servicing transistorized circuits with the TELEVISION ANALYST.

Remember this one important precaution when using signal injection in transistor stages: *TOO MUCH VOLTAGE WILL BURN OUT A TRANSISTOR.* This is especially true when too much voltage is applied across the base-emitter junction. Such applications, even accidentally for only a fraction of a second, will break down the base-emitter junction and the transistor will have to be replaced. Most of the output signals from the TELEVISION ANALYST can be used in transistor stages, even at maximum amplitude. Precaution must be used only with the following output signals:

1. Do not use the HORIZ GRID DRIVE output in transistorized circuits.
2. Use the sync output at low level in transistorized circuits. The asterisk (*) on the SYNC control setting represents the highest level (10 volts peak-to-peak) that should be used unless you have checked the manufacturer's data and are absolutely sure that higher levels are normally used in the circuit.
3. Use the BIAS voltage at low level in transistorized circuits. The asterisk (*) on the BIAS control setting represents the highest level (12.5 volts) that should be used unless you have checked the manufacturer's data and are absolutely sure that higher levels are normally used in the circuit.

When injecting sync signals, we recommend that you make it a habit to keep the SYNC control at 0 when not in use. Then, if you happen to make a circuit connection before you adjust the level, it will not burn out a transistor. After injecting the sync signal, make sure the amplitude is reduced to a safe level before changing the point of injection. A safe level in one circuit may not be safe in another circuit. When possible, select an injection point that will route the signal through a series resistor into the transistor base. The resistor will help absorb the signal and help protect the transistor.

When injecting the bias voltage, always apply it to provide forward bias across the base-emitter junction. When possible, select an injection point that will route the signal through a series resistor into the transistor base. The resistor will absorb much of the voltage difference and prevent possible damage to the transistor. There is normally only a few tenths of a volt forward bias for most transistors.

Be careful of the reference point that is used. Usually, it is preferable to use the emitter of the transistor as reference, rather than chassis ground. In both examples shown in Figure 37, chassis ground cannot be used as reference. If used, a low or zero setting on the BIAS control would place a substantial difference of potential (18.5 volts in one case, 34 volts in the other case) across the base-emitter junction the instant the test lead is touched to the base of the transistor. The result would be a burned out transistor.

Transistors are very dependable components and should not be replaced until it is proven that they are actually defective. Sometimes another defective component in the circuit will cut off the transistor and it will appear defective. Even when the transistor is proven defective, a check of other components in the circuit is wise. Many times, a defective component caused the transistor to burn out in the first place. Replacing the transistor without replacing the other defective part will just result in another burned out transistor.

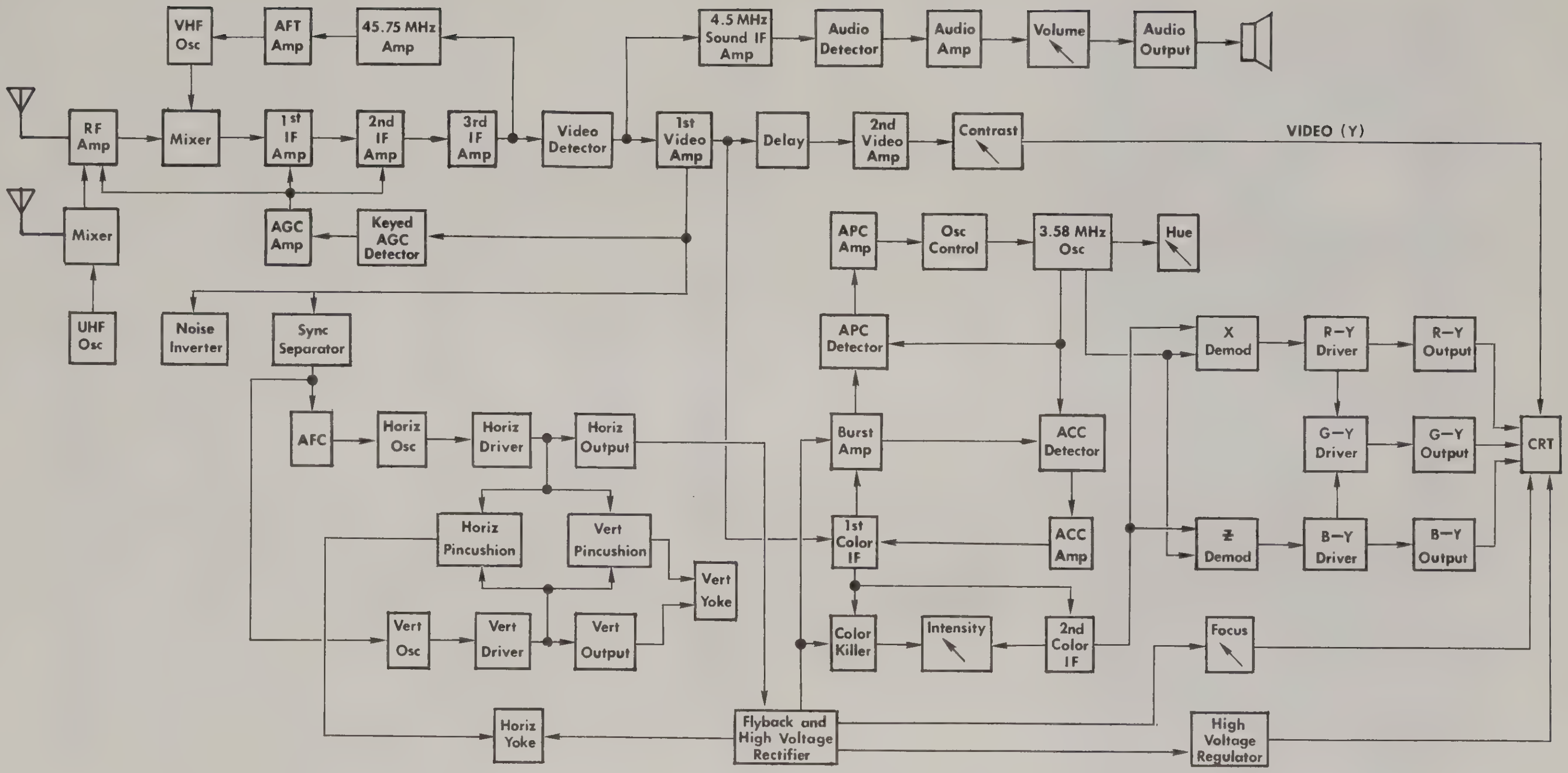


Figure 35. Block Diagram of Typical Transistorized Color Television Receiver

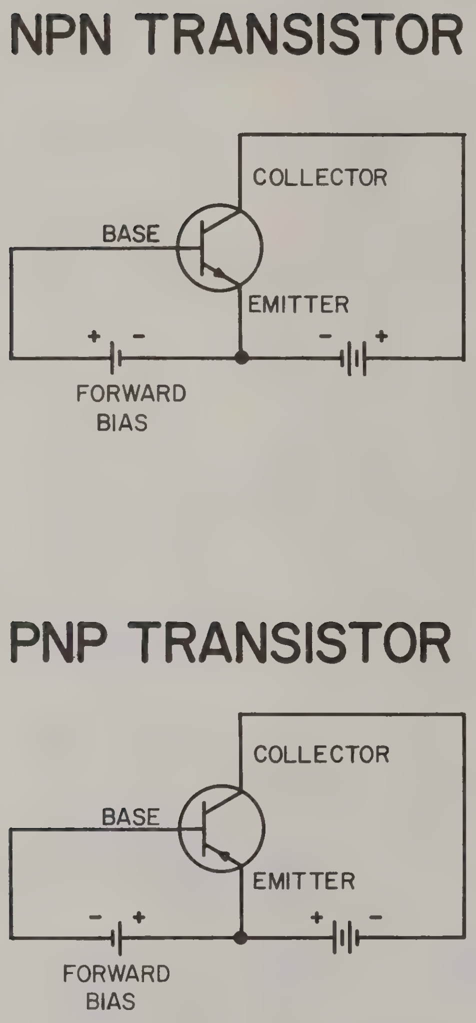


Figure 36. Transistor Biasing

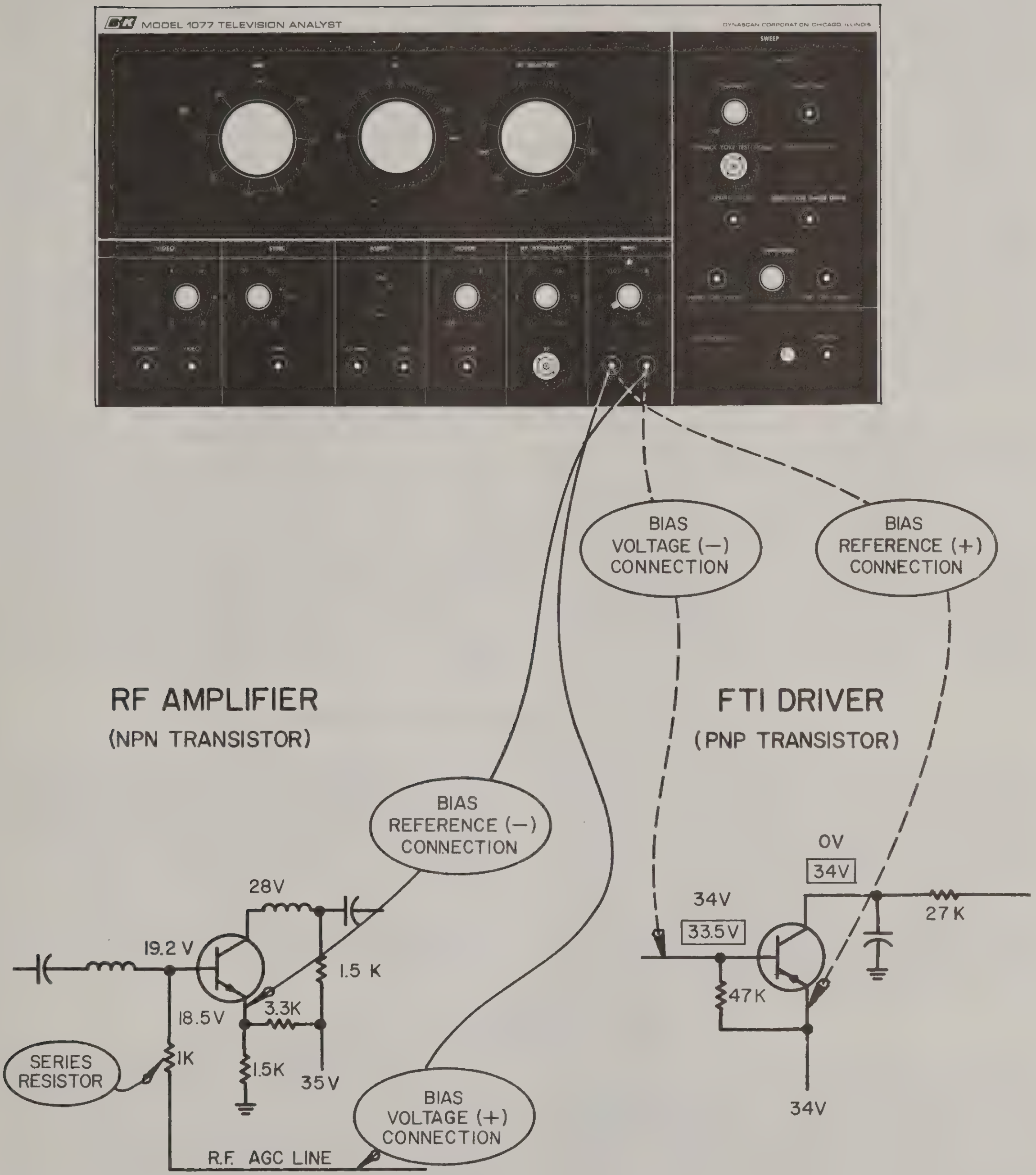

MODEL 1077 TELEVISION ANALYST
DYNASCAN CORPORATION CHICAGO ILLINOIS
SWEEP
BIAS VOLTAGE (−) CONNECTION
BIAS REFERENCE (+) CONNECTION
RF AMPLIFIER
(NPN TRANSISTOR)
FTI DRIVER
(PNP TRANSISTOR)
BIAS REFERENCE (−) CONNECTION
28V
19.2 V
1.5 K
3.3K
18.5V
SERIES RESISTOR
1K
1.5K
35V
BIAS VOLTAGE (+) CONNECTION
R.F. AGC LINE
0V
34V
34V
33.5V
27 K
47K
34V

Figure 37. Proper Bias Connection for Transistor Stages

C. TROUBLESHOOTING TUNED AMPLIFIERS

(See Figure 38)

Tuned amplifiers are stages which amplify signals within a specific frequency band, and block signals of other frequencies. The stages are characterized by transformer coupling between stages. Such stages in a television receiver are the rf amplifier, i-f amplifiers, 4.5 MHz sound i-f amplifier, and color i-f amplifiers.

Troubleshooting of all tuned amplifiers is done in essentially the same manner. First, the injected signal must be of the correct frequency. With the TELEVISION ANALYST, the vhf signal is of the correct frequency for the channel indicated on the RF SELECTOR. The frequency of the uhf signal is selected by the UHF control. An i-f signal must be set to the proper frequency by the IF control. The IF control may be adjusted to provide the best display while injecting the signal. The 4.5 MHz signal and the color signal are stable, fixed-frequency sources that will provide the correct frequency without adjustment.

Second, the signal is injected at the input (grid of tube or base of transistor) of the suspected stage that is farthest from the antenna. The input of the stage is preferred because the low impedance signal source is less likely to load the tuned circuit which may affect its frequency response. If no display is provided, this is probably the defective stage. If the desired results are obtained (test pattern, color, or sound depending upon the stage being tested), reduce the amplitude of the injected signal until the display is barely visible (the sound signal is not adjustable in amplitude).

Third, move the injection point to the input of the next stage nearer the antenna. If that stage is operating properly, the display will be much brighter. The amplification of the stage should produce the brighter display. This method not only locates inoperative stages, but weak stages as well. Reduce the signal amplitude again to the point where the display is barely visible. Note the difference in the setting of the amplitude adjustment, which is a relative indication of gain. After checking a few television receivers, you will soon learn the normal gain to be expected in various stages. This information will help you spot a weak stage immediately.

Fourth, continue to move the point of signal injection toward the antenna one stage at a time until no display or a poor display is produced. When this occurs, the defective stage has been located. Now, we must locate the defective component within the stage.

Fifth, inject the signal at the secondary and primary of the coupling transformer. If no display is produced with signal injected at the secondary, the coupling capacitor is probably defective. If the display is normal with signal injected at the secondary, but no display is produced when signal is injected at the primary, the transformer is probably defective. If the display is normal with signal injected at the primary, check collector, emitter, and base voltages (plate, cathode, and grid voltages). If any voltages are abnormal, make resistance checks of resistors and capacitors until the defective part is located.

D. TROUBLESHOOTING UNTUNED AMPLIFIERS

(See Figure 39)

Untuned amplifiers differ from tuned amplifiers, described in the previous paragraphs, in that they amplify a wide band of frequencies. Resistive-capacitive coupling is normally used between stages. Such stages in a television receiver include the audio amplifiers and video amplifiers.

Troubleshooting of untuned amplifiers is performed by injecting signal at the output of the stage farthest from the antenna to produce normal operation. For video signals, the signal amplitude is decreased until the display is barely visible, then the point of injection is changed to the input of the stage. If the stage is operative, the amplification should produce a brighter display. For audio, listen for a louder volume when the signal is moved to the input of the stage.

Continue moving the point of injection toward the antenna until no output is obtained. This is the defective stage.

E. TROUBLESHOOTING PULSE STAGES

(See Figure 40)

Pulse circuits have short duration of operation compared to off time. Such stages in a television receiver include the sync separator, sync amplifiers, keyed agc circuit, burst amplifier, horizontal and vertical sweep circuits. In these stages, wave shaping as well as operation is important. The TELEVISION ANALYST is invaluable in troubleshooting pulse circuits. It substitutes the type of signal actually used in the stage during normal operation. Other methods of troubleshooting provide doubtful or hard to interpret results. The TELEVISION ANALYST can easily locate causes of distortion or inoperation because the results are displayed directly on the screen of the television set with the malfunction. Signals are injected at every point in the series path of the pulse signal (see Figure 40) until the point is located at which the display is abnormal.

The only special procedure to remember when injecting signals into pulse stages is selection of the correct polarity. In some stages, a positive pulse is required, while others require a negative pulse. Amplifiers usually invert the signal, thus the polarity must be reversed as the point of injection is changed from one stage to the next, or from the output to the input of a stage. The video and sync signals from the TELEVISION ANALYST have reversible polarities. The agc, vertical, and horizontal sweep circuits in television receivers require only positive pulses.

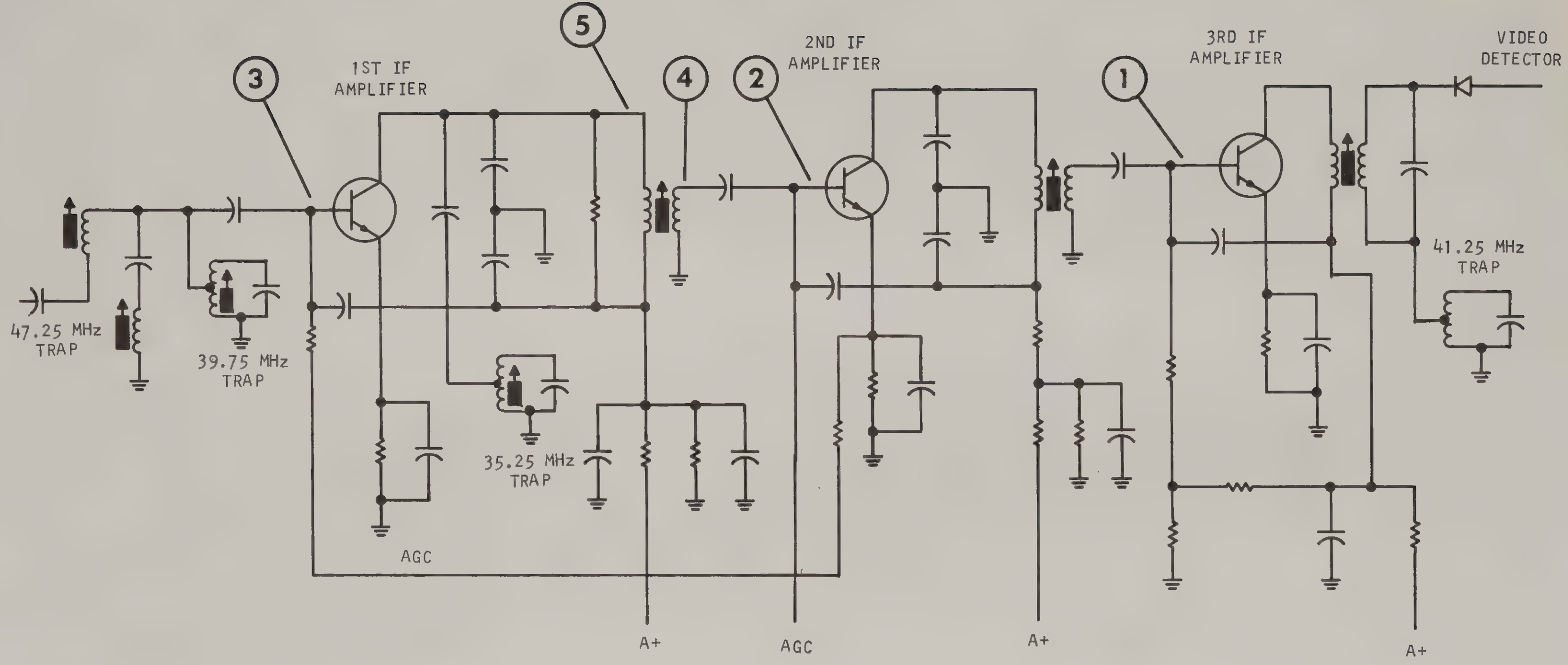


Figure 38. Typical Tuned Amplifier Schematic Diagram

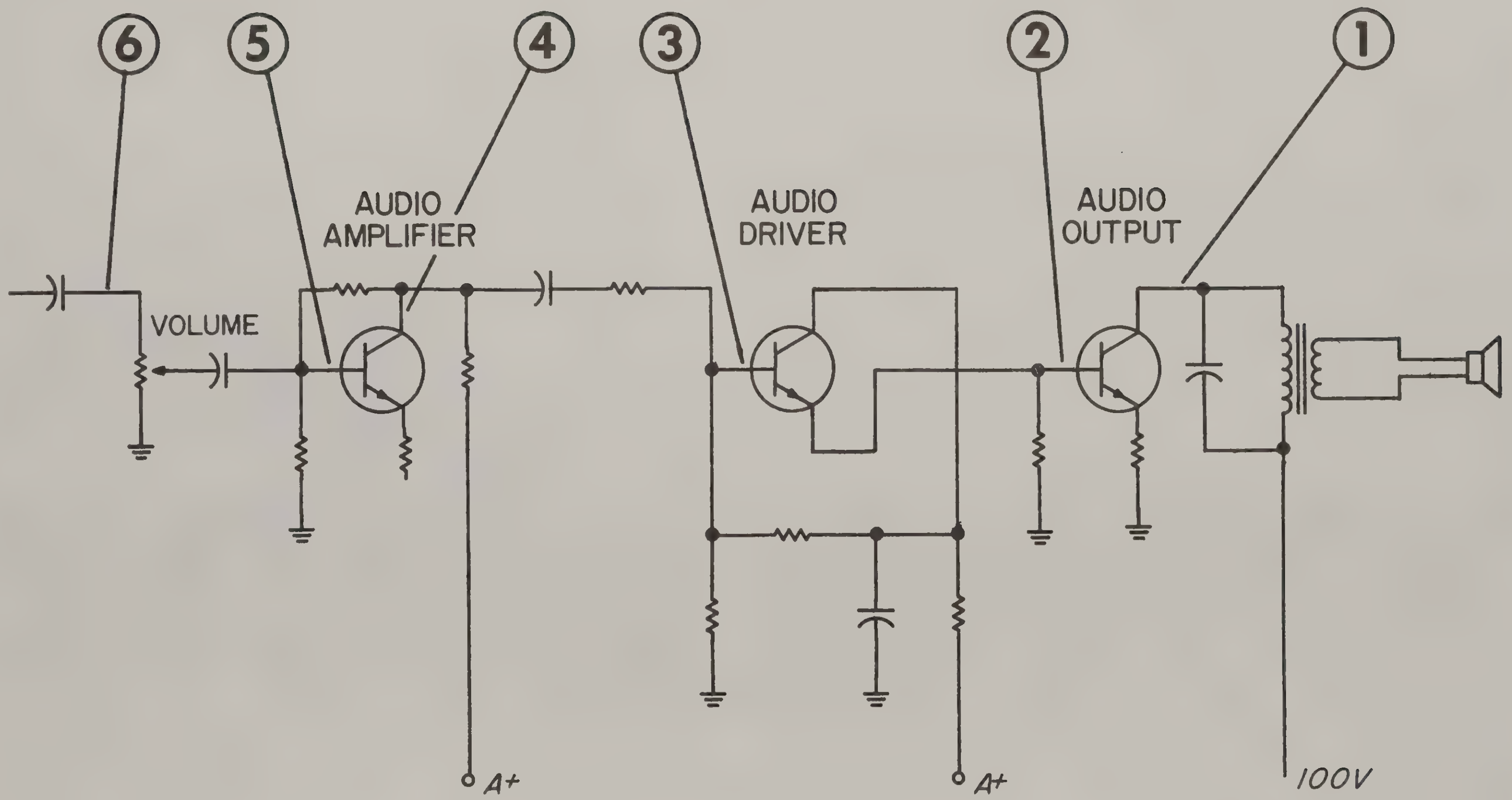


Figure 39. Typical Untuned Amplifier Schematic Diagram

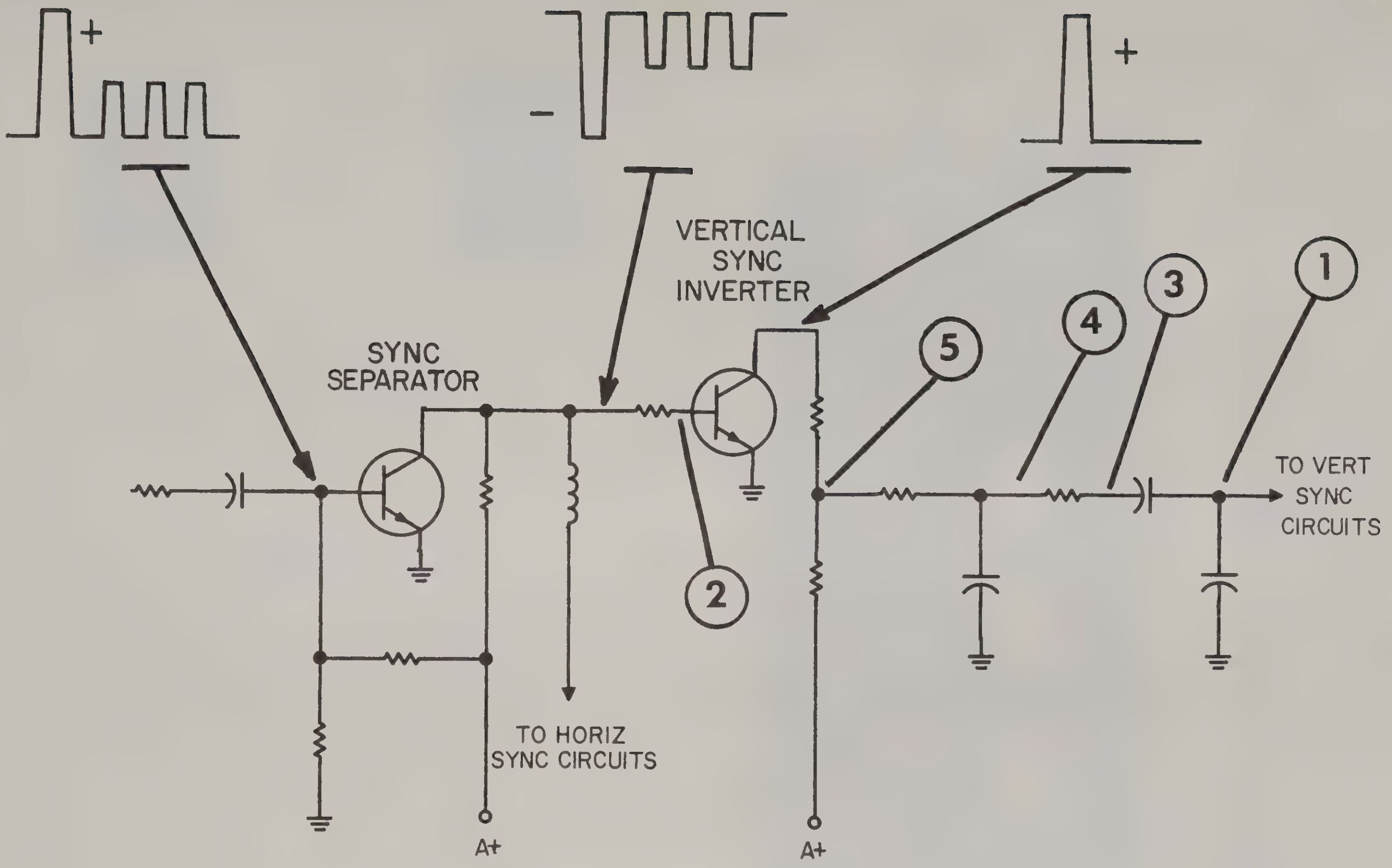


Figure 40. Typical Pulse Stage Schematic Diagram

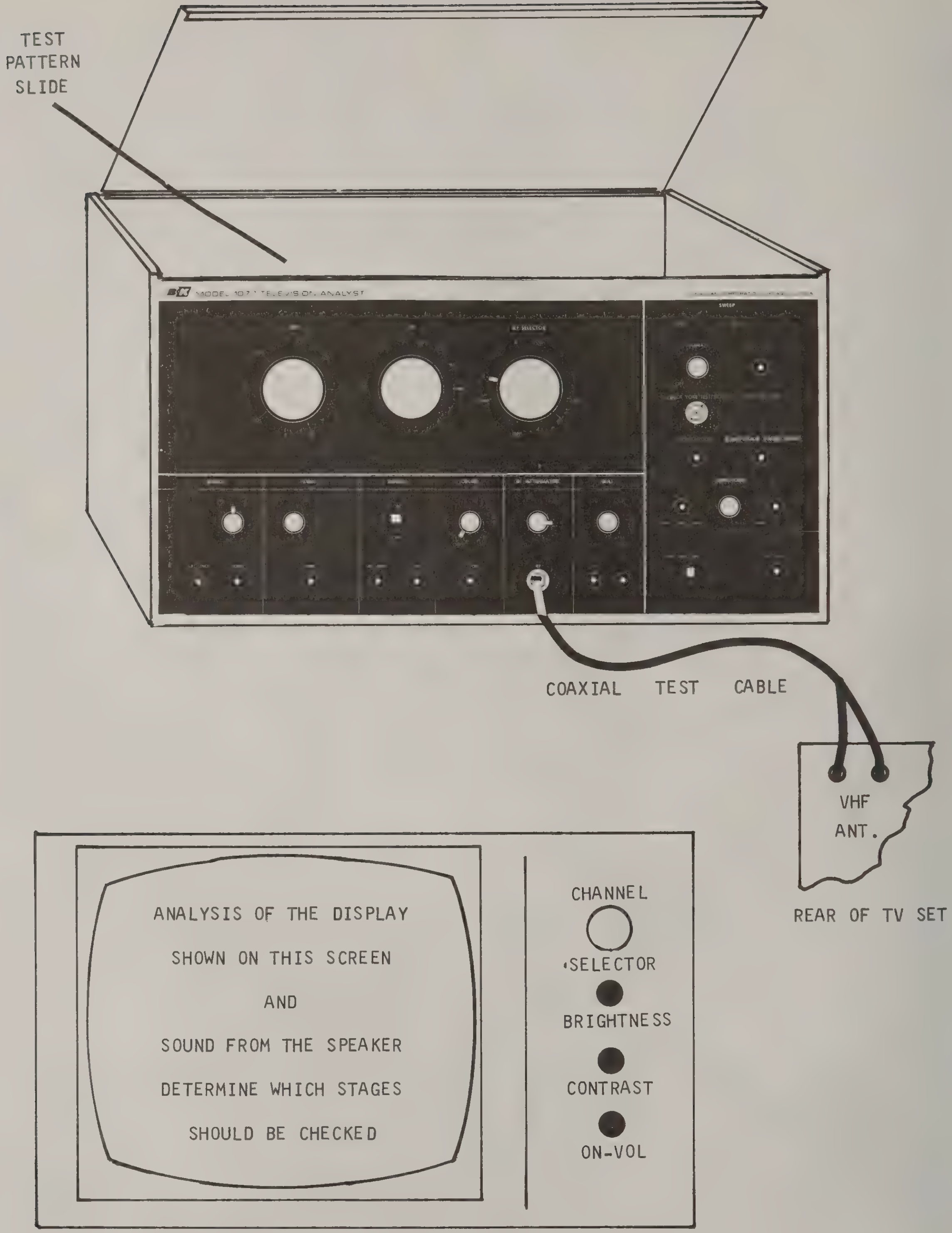


Figure 41. Injecting VHF Signal and Analyzing Symptoms

TROUBLESHOOTING PROCEDURES

A. SYMPTOM ANALYSIS

(See Figure 41)

1. Always start troubleshooting by injecting a vhf test signal at the antenna terminals of the television receiver with the malfunction and checking the symptoms. Complete procedures are given in the *VHF Signal* portion of the *Typical Operating Procedure.*

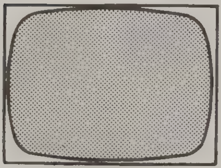
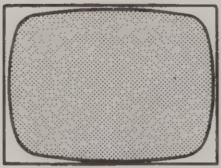
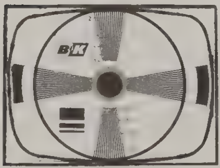
2. Use the video test pattern from the TELEVISION ANALYST, not a picture from a television station. The picture broadcast by a television transmitter continuously changes, but the test pattern is reliable. If the display does not match the test pattern slide, it is easily detected. Small irregularities would not be seen easily with a transmitted picture.

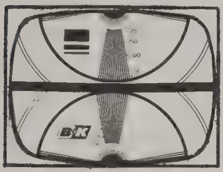
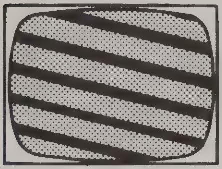
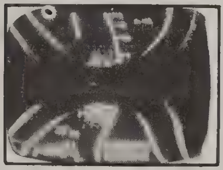
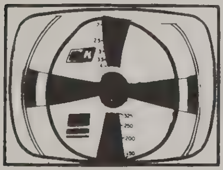
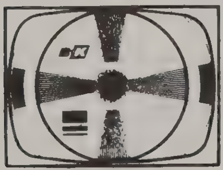
3. Analyze the symptoms thoroughly. A careful check of symptoms will direct you to specific stages that could cause the trouble. Do not rely on another person's description of the symptoms. You may gain additional information that will save you time by making your own observations. Check both video and sound, and if a color set, check color reception.

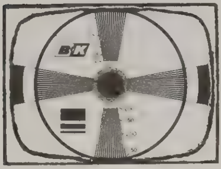
4. Learn to analyze the test pattern. It shows much more than merely whether the television receiver is operating or not operating. It provides a complete check of overall performance and shows whether adjustments are necessary. Additional insight into locating troubles that do not disable a television receiver but do inhibit peak performance is given in the *Performance Testing* section of this manual. After repairing a trouble that has disabled the television receiver, the performance tests should be made and corrective measures taken to restore peak performance. Such action will reduce "call backs" and improve customer satisfaction.

5. The following table correlates the symptoms with the stages that could produce the symptoms if a component failed in that stage. The table is based upon an analysis of the circuits in a television receiver.

SYMPTOM	POSSIBLE CAUSE	CORRECTIVE PROCEDURE
NO RASTER NO SOUND 	No low voltage or B+ No filaments	Paragraph B
NO RASTER SOUND NORMAL 	No high voltage High voltage rectifier Flyback transformer Horizontal yoke Horizontal output tube (or transistor) Horizontal oscillator High voltage regulator Bad picture tube Blanking circuit	Paragraph C

SYMPTOM	POSSIBLE CAUSE	CORRECTIVE PROCEDURE
NO VERTICAL DEFLECTION 	Vertical yoke Vertical output tube (or transistor) Vertical oscillator Vertical output transformer	Paragraph D
NO VIDEO SOUND NORMAL 	Video output Video driver CRT	Paragraph E
NO VIDEO NO SOUND 	Video detector 1st i-f amplifier 2nd i-f amplifier 3rd i-f amplifier RF amplifier Oscillator Mixer	Paragraph F
NO SOUND VIDEO NORMAL 	Speaker Audio output tube (or transistor) Audio amplifier Discriminator 4.5 MHz amplifier Audio output transformer	Paragraph G

SYMPTOM	POSSIBLE CAUSE	CORRECTIVE PROCEDURE
NO VERTICAL SYNC 	Vertical sync inverter Sync separator	Paragraph H
NO HORIZONTAL SYNC 	Sync separator Horizontal AFC	Paragraph I
OVERLOADED VIDEO 	AGC detector AGC amplifier AGC line	Paragraph J
NON-LINEAR SWEEP 	Requires adjustment Pincushion amplifier (color)	Adjustment Section Paragraph A
POOR RESOLUTION 	Needs i-f alignment	Performance Testing Section Paragraph E

SYMPTOM	POSSIBLE CAUSE	CORRECTIVE PROCEDURE
NO COLOR BLACK AND WHITE NORMAL 	Color oscillator Color i-f amplifiers Color killer	Paragraph K
ONE COLOR ABSENT ALL COLORS INCORRECT	Demodulator Color amplifier Picture tube	Paragraph L
NO COLOR SYNC DIAGONAL COLOR BARS ACROSS SCREEN CAUSING "BARBER POLE" EFFECT	Burst amplifier Phase detector Phase amplifier Color oscillator Color oscillator control	Paragraph M

B. NO RASTER—NO SOUND

(See Figure 42)

The most probable cause of this symptom is the absence of one of the B+ voltages, possibly all low dc voltages. In most television receivers, this is the only portion common to the sound and high voltage sections. In vacuum tube television receivers, it is also possible that filament voltage is absent or interrupted.

The NO RASTER—NO SOUND chart provides a procedure that will isolate the defective stage. The first step is a visual check of the dial light or tube filaments. For a fully transistorized set without a dial light, start with step 2.

C. NO RASTER—SOUND NORMAL

(See Figure 43)

This symptom appears whenever the picture tube does not have the proper electron beam to illuminate the screen. This could be caused by a bad picture tube or absence of voltage on cathode or grids of the picture tube, but usually by absence of high voltage on the anode of the picture tube. High voltage, in turn, is dependent upon the horizontal sweep signal. There are quite a number of stages in which the trouble could be located, therefore an orderly procedure is required to locate the defective component quickly. The following procedure should lead you to the defect in minimum time.

It is assumed, as with all symptoms, that vacuum tubes already have been tested or substituted and the symptom remained unchanged. With this symptom, the picture tube also should have been tested because it is a prime suspect.

WARNING

DANGEROUS HIGH VOLTAGE RF AND DC IS PRESENT IN THESE CIRCUITS. TURN OFF THE TELEVISION RECEIVER WHILE MAKING CONNECTIONS. MAKE CLIP TYPE CONNECTIONS AND KEEP HANDS OUT OF THE CHASSIS WHILE IT IS TURNED ON.

1. Set the brightness and contrast controls on the television receiver to maximum.
2. Disconnect the plate cap from the high voltage rectifier tube. Clip the high voltage probe of the TELEVISION ANALYST around the plate cap lead.

   If the lamp in the high voltage probe lights, high voltage rf is being developed by the flyback transformer and the trouble lies between the transformer and the picture tube. Additional isolation procedures continue in step 3.

   If the lamp does not light, the trouble lies in the flyback transformer or horizontal sweep circuitry. Proceed directly to step 7 for additional isolation procedure.
3. Replace the cap on the high voltage rectifier tube. If the lamp in the high voltage probe goes off, there is a short in the high voltage circuit. Procedures for locating the short are continued in step 4. If the lamp stays on, go directly to step 5.
4. Disconnect the high voltage lead from the picture tube anode. If the light comes on, there is an internal high voltage short in the picture tube. If the lamp stays off, disconnect any filter capacitors, bleeder resistor, or other component one at a time until the lamp comes on. The defective part is now located.

WARNING

IN MANY TELEVISION RECEIVERS, HIGH VOLTAGE (APPROXIMATELY 20,000 VOLTS) MAY BE PRESENT AFTER THE SET IS TURNED OFF. GROUND THE HIGH VOLTAGE CIRCUIT WITH A WELL INSULATED TEST LEAD BEFORE HANDLING.

5. With the television receiver off, check continuity of all parts in the high voltage rectifier filament circuit. Make sure a tight connection is made where the high voltage lead connects to the anode of the picture tube. If good, go to step 6.
6. Check dc voltages at the cathode and all grids of the picture tube. Isolate the reason for any missing voltage.
7. Replace the plate cap on the high voltage rectifier tube. Inject HORIZONTAL PLATE DRIVE signal at the plate of the horizontal output tube. Complete procedures are given in the *Horizontal Plate Drive and Boost Indication* portion of the *Typical Operating Procedure.*

If the lamp in the high voltage probe lights and the BOOST INDICATOR lamp lights and raster is restored on the picture tube, the flyback transformer and associated circuitry are proven good. The trouble lies in the horizontal sweep stages. Proceed directly to step 13 for trouble isolation procedures.

If the BOOST INDICATOR lights but the high voltage lamp does not, there is an open turn in the flyback transformer between the plate of the horizontal output and the plate of the high voltage rectifier.

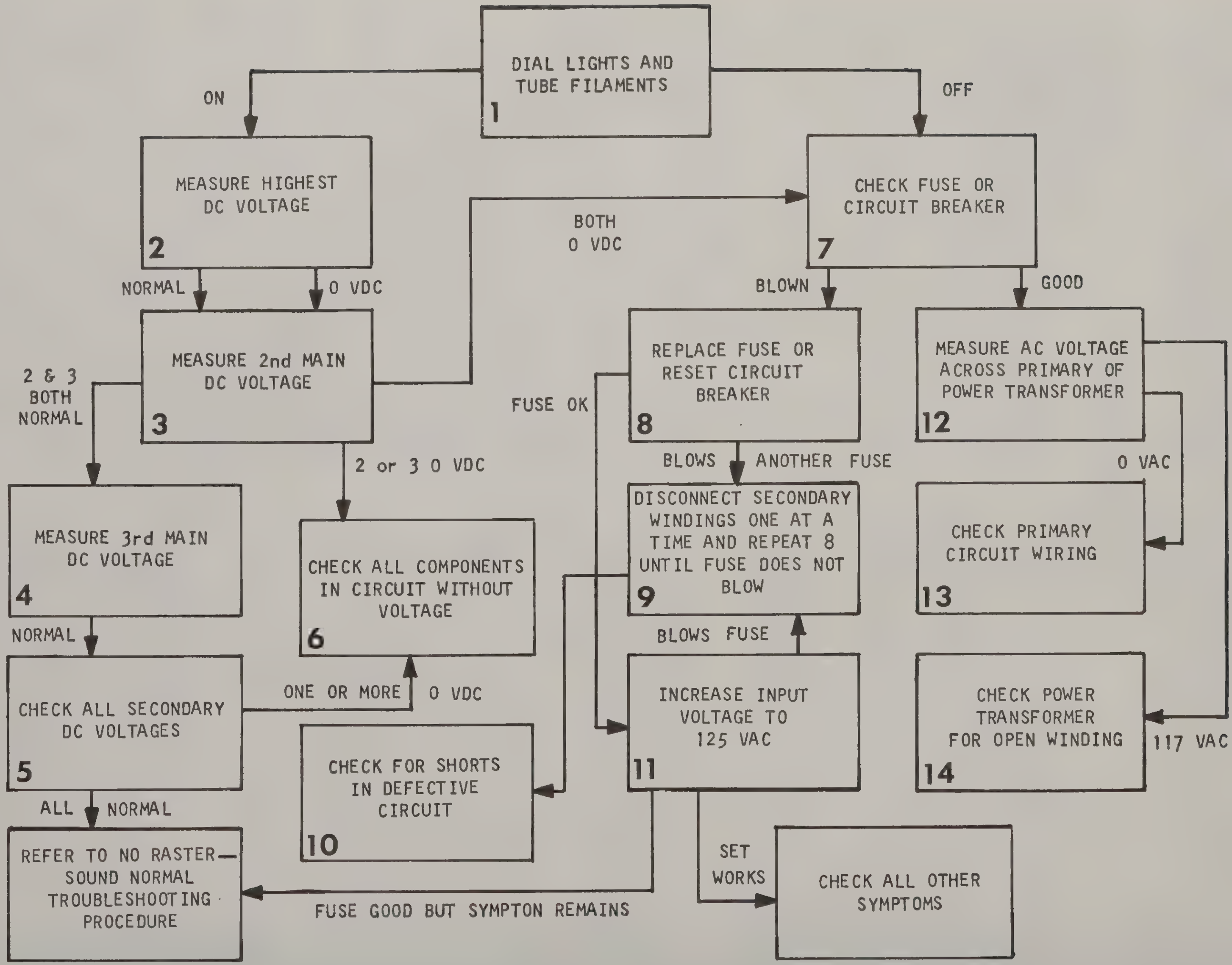
If neither lamp lights, the flyback transformer, horizontal yoke, or damper stage is defective. To isolate the defective part, proceed to step 8.

The flyback transformer and damper stage generate the boosted B+ voltage which is used as plate voltage for the horizontal output stage (sometimes it is also used for focus voltage on the picture tube, as plate voltage for the vertical output stage, and other stages). If B+ is not boosted, insufficient plate drive is developed to provide a raster.

Naturally, if the flyback transformer or horizontal yoke is open, no raster will be developed.

If the flyback transformer or horizontal yoke has shorted windings, it will load the horizontal output stage and attenuate the flyback pulse to prevent high voltage and boosted B+ from being developed.

8. Remove the damper tube from its socket and measure the dc voltage at the plate pin of the tube socket. B+ voltage should be measured. If zero or unusually low reading is obtained,


DIAL LIGHTS AND TUBE FILAMENTS
1
ON
OFF
MEASURE HIGHEST DC VOLTAGE
2
CHECK FUSE OR CIRCUIT BREAKER
7
NORMAL
0 VDC
BOTH 0 VDC
BLOWN
GOOD
MEASURE 2nd MAIN DC VOLTAGE
3
2 & 3 BOTH NORMAL
2 or 3 0 VDC
REPLACE FUSE OR RESET CIRCUIT BREAKER
8
FUSE OK
MEASURE AC VOLTAGE ACROSS PRIMARY OF POWER TRANSFORMER
12
BLOWS ANOTHER FUSE
0 VAC
MEASURE 3rd MAIN DC VOLTAGE
4
CHECK ALL COMPONENTS IN CIRCUIT WITHOUT VOLTAGE
6
DISCONNECT SECONDARY WINDINGS ONE AT A TIME AND REPEAT 8 UNTIL FUSE DOES NOT BLOW
9
CHECK PRIMARY CIRCUIT WIRING
13
NORMAL
BLOWS FUSE
ONE OR MORE
0 VDC
CHECK ALL SECONDARY DC VOLTAGES
5
INCREASE INPUT VOLTAGE TO 125 VAC
11
CHECK POWER TRANSFORMER FOR OPEN WINDING
14
117 VAC
CHECK FOR SHORTS IN DEFECTIVE CIRCUIT
10
ALL
NORMAL
SET WORKS
REFER TO NO RASTER—SOUND NORMAL TROUBLESHOOTING PROCEDURE
CHECK ALL OTHER SYMPTOMS
FUSE GOOD BUT SYMPTON REMAINS

Condensed Troubleshooting Procedure—NO RASTER—NO SOUND (See Figure 42)

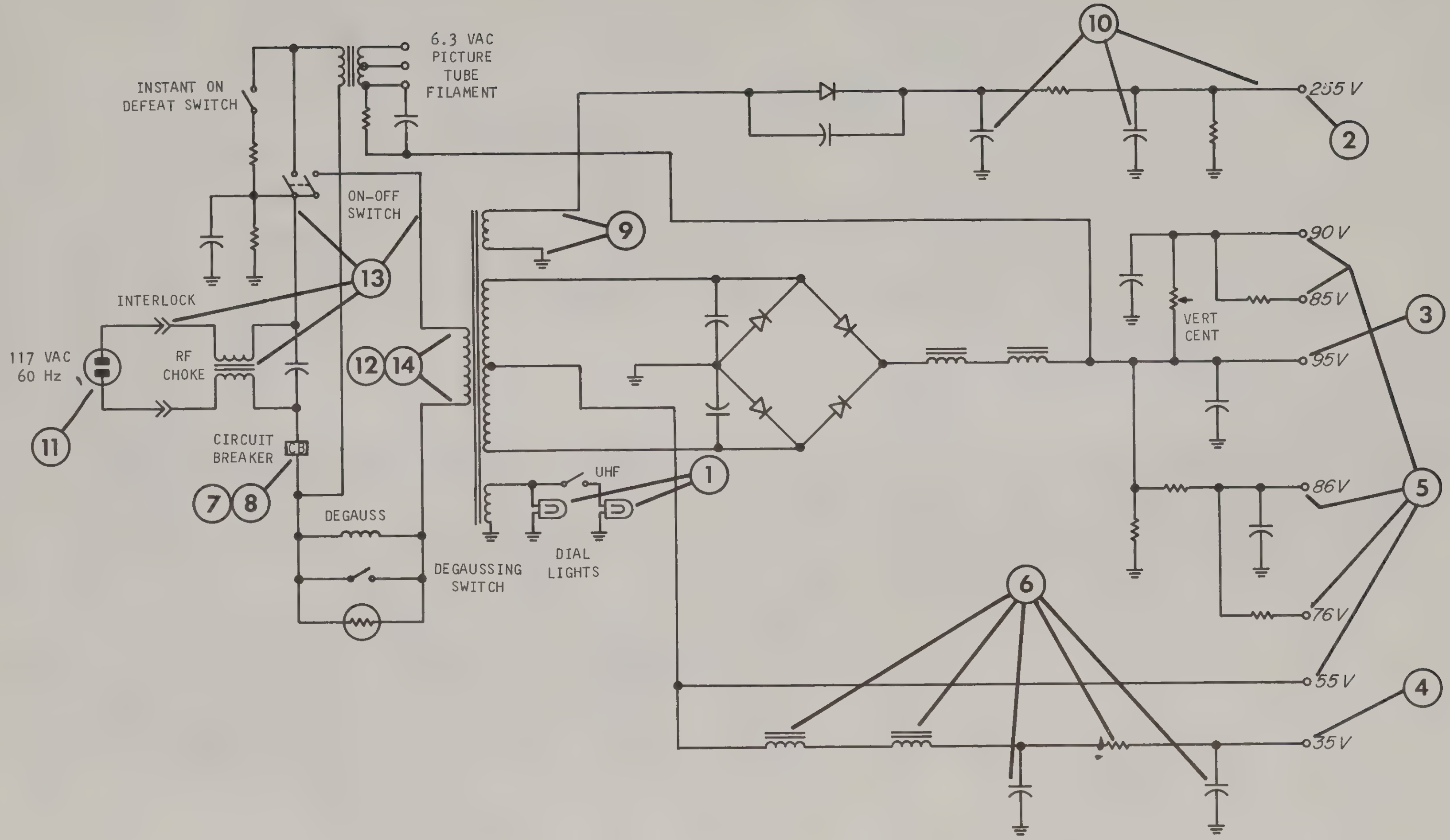
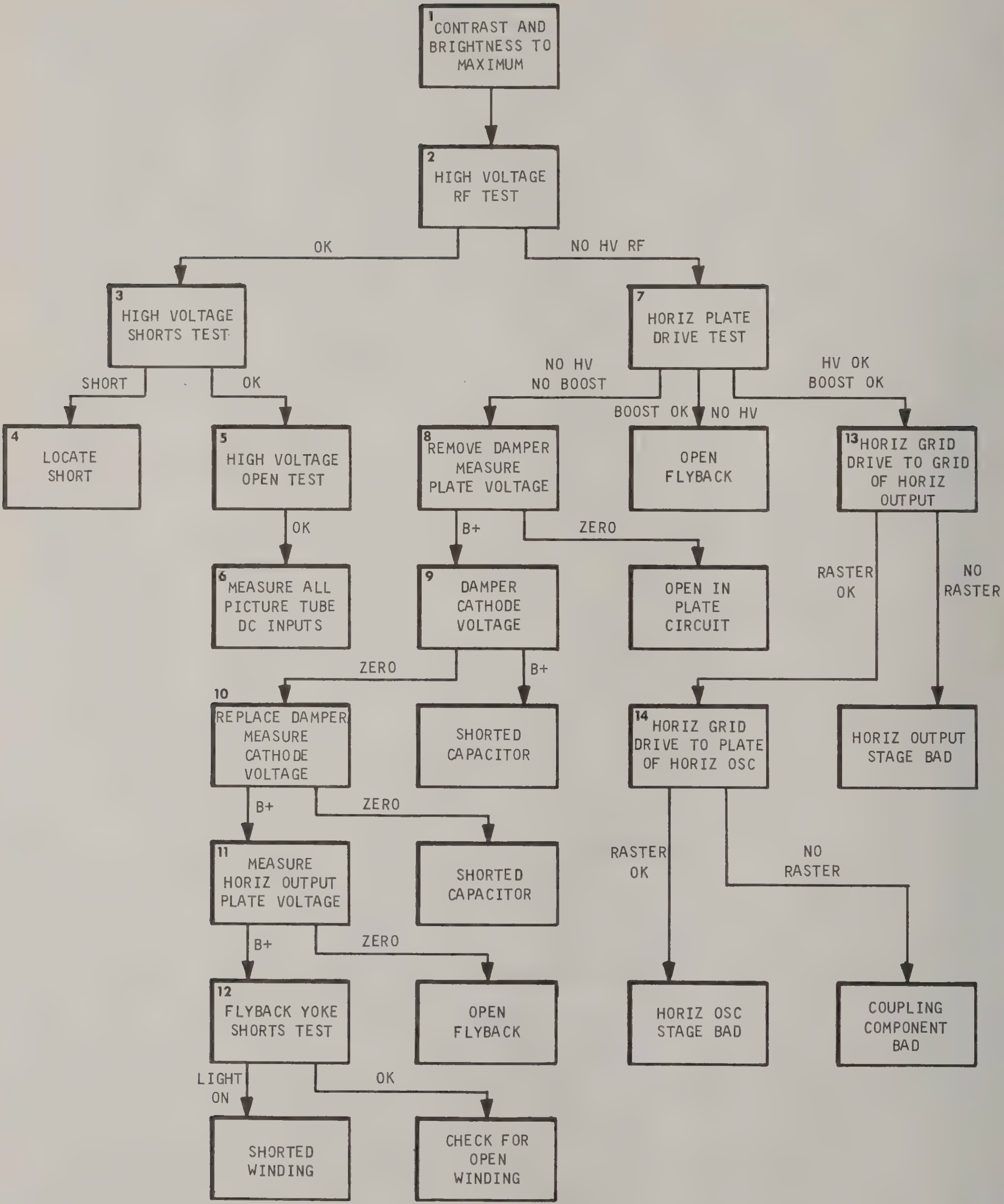
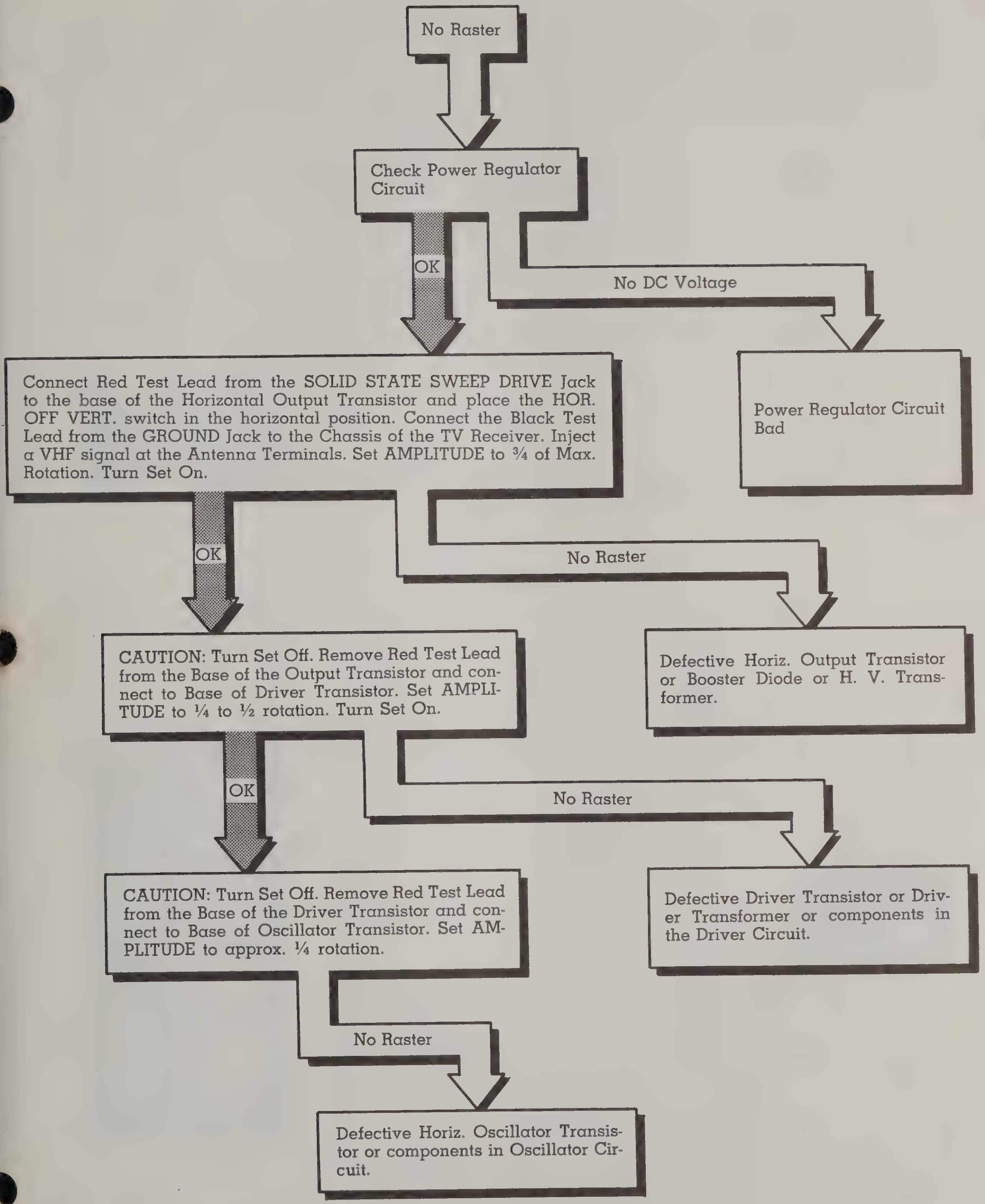


Figure 42. Typical Power Supply Schematic Diagram



Condensed Troubleshooting Procedure—NO RASTER—SOUND NORMAL (See Figure 43)



Check Power Regulator Circuit

Power Regulator Circuit Bad

Connect Red Test Lead from the SOLID STATE SWEEP DRIVE Jack to the base of the Horizontal Output Transistor and place the HOR. OFF VERT. switch in the horizontal position. Connect the Black Test Lead from the GROUND Jack to the Chassis of the TV Receiver. Inject a VHF signal at the Antenna Terminals. Set AMPLITUDE to ¾ of Max. Rotation. Turn Set On.

Defective Horiz. Output Transistor or Booster Diode or H. V. Transformer.

CAUTION: Turn Set Off. Remove Red Test Lead from the Base of the Output Transistor and connect to Base of Driver Transistor. Set AMPLITUDE to ¼ to ½ rotation. Turn Set On.

Defective Driver Transistor or Driver Transformer or components in the Driver Circuit.

CAUTION: Turn Set Off. Remove Red Test Lead from the Base of the Driver Transistor and connect to Base of Oscillator Transistor. Set AMPLITUDE to approx. ¼ rotation.

Defective Horiz. Oscillator Transistor or components in Oscillator Circuit.

Condensed Troubleshooting Procedure No Raster. Solid State Sets See Page 39.

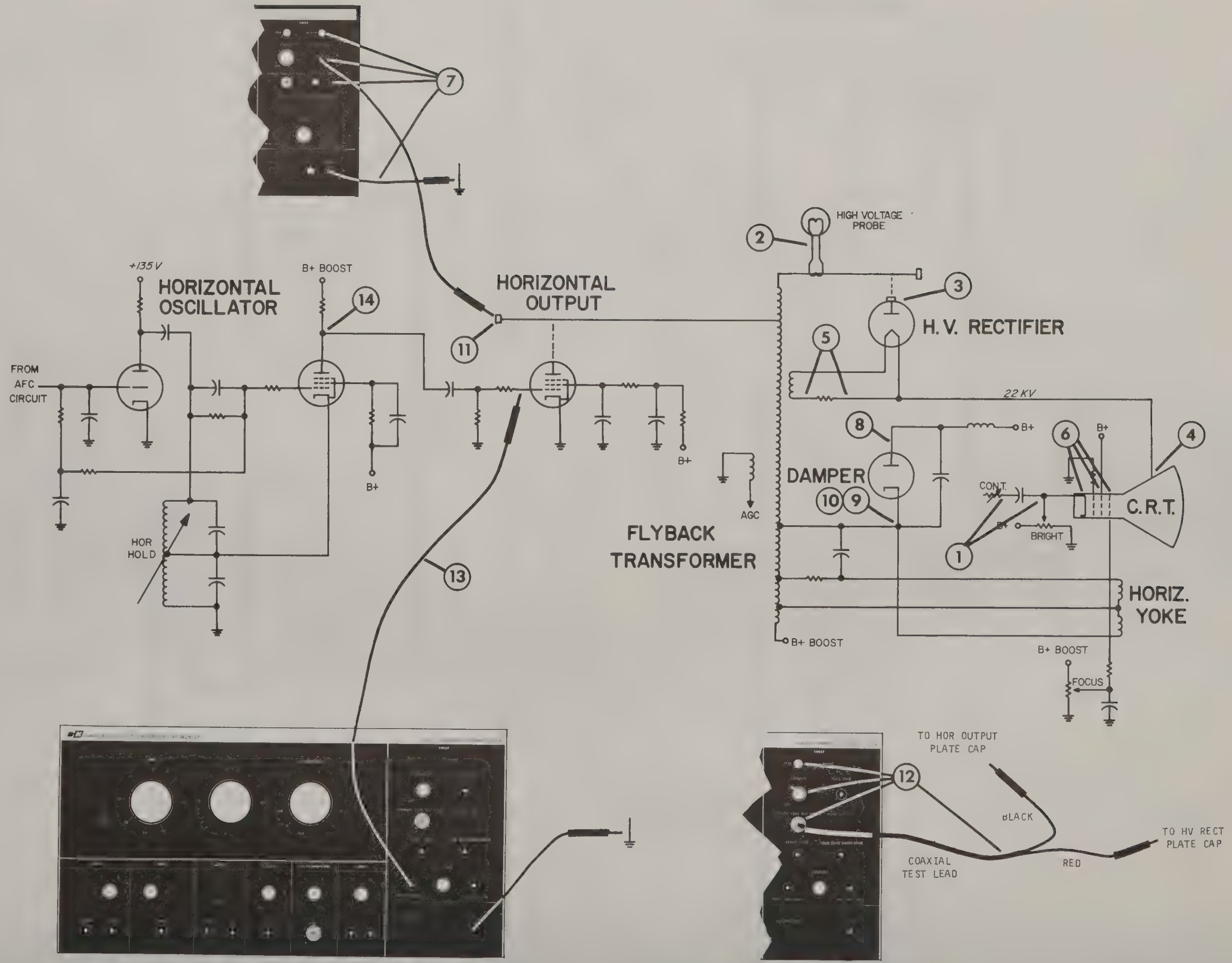


Figure 43. Typical Horizontal Sweep and High Voltage Section Schematic Diagram

measure resistances of parts in the plate circuit. If normal, go to step 9.

9. With the damper tube still removed, measure the dc voltage at the cathode. Zero volts should be measured. If B+ is measured, check for a shorted capacitor between the B+ and boosted B+ lines. If normal, go to step 10.

10. Replace the damper tube and again measure cathode voltage. B+ or boosted B+ should be measured. If zero or unusually low, check for a shorted capacitor in the cathode circuit. If normal, go to step 11.

11. Measure the dc voltage at the plate lead of the horizontal output tube. B+ or boosted B+ should be measured. If zero, check for an open circuit in the flyback transformer or other series component between the damper and the horizontal output stages. If normal, go to step 12.

12. Make the flyback transformer and horizontal yoke shorted windings test. Complete procedures are given in the FLYBACK YOKE TEST SIGNAL portion of the *Typical Operating Procedure.* If no shorts are indicated, make continuity checks of the entire flyback transformer and horizontal yoke to check for an open circuit.

13. Replace the plate cap (or resolder the plate lead) to the horizontal output tube. Inject the HORIZ GRID DRIVE jack output signal to the grid of the horizontal output tube. If raster is not restored, check screen grid and cathode circuit components. If raster is restored, go to step 14.

14. Inject the HORIZ GRID DRIVE jack output signal to the plate of the horizontal oscillator stage. If raster is not produced, check the coupling capacitor. If raster is produced, the trouble lies in the horizontal oscillator stage. Make voltage and resistance checks throughout the horizontal oscillator stage until the defective component is located.

EXCEPTIONS FOR TRANSISTORIZED SETS

1. If a solid state diode is used for a damper, disconnect the diode for measurements which specify that the damper tube be removed.
2. Do not use the HORIZ GRID DRIVE signal in transistorized circuits. SOLID STATE SWEEP DRIVE output signal and its use for horizontal deflection circuits is illustrated on page 39 & 40. Reference may also be made to the condensed procedure "No raster, solid state sets" on page 69.

D. NO VERTICAL DEFLECTION

(See Figure 44a)

This symptom can be caused by a component failure in the vertical oscillator, vertical output stage, vertical output transformer and associated parts, or vertical yoke. Isolate the trouble with the TELEVISION ANALYST by the following procedure:

1. Disconnect the vertical yoke and inject the SOLID STATE SWEEP DRIVE VERTICAL SIGNAL. Complete procedures are given in the *Vertical Yoke Test Signal* portion of the *Typical Operating Procedure.* If necessary, connect a jumper to complete test path.

   If vertical deflection is produced (although nonlinear), it proves that the vertical yoke is good. Go to step 2.

   If no vertical deflection is produced, the vertical yoke is open or completely shorted. A few shorted turns will cause the vertical deflection to "keystone" (less height on one side of the screen than the other).

2. Reconnect the vertical yoke and remove the vertical output tube. Inject a VERTICAL PLATE DRIVE signal at the plate lead of the vertical output stage and adjust the AMPLITUDE control to fill the screen. Complete procedures are given in the *Vertical Plate Drive Signal* portion of the *Typical Operating Procedure.*

   If vertical deflection is produced, it proves that the vertical output transformer and associated components that couple the signal from the vertical output stage to the vertical yoke are good. Go to step 3.

   If no vertical deflection is produced, the trouble is in the vertical output transformer or associated circuit. Check B+ voltage to the vertical output stage and make resistance checks to locate the defective part.

3. Replace the vertical output tube. Inject the VERTICAL GRID DRIVE signal at the grid of the vertical output stage. Set the AMPLITUDE control to minimum before injecting signal and increase slowly to see if vertical deflection is produced. Refer to the *Vertical Grid Drive Signal* portion of the *Typical Operating Procedure* for complete procedures.

   If vertical deflection is produced, the vertical output stage is good. Go to step 4.

   If vertical deflection is not produced, the trouble is in the vertical output stage. Check screen grid and cathode components.

4. Inject the VERTICAL GRID DRIVE signal at the plate of the vertical oscillator stage. If vertical deflection is not produced, check coupling components between the vertical oscillator and the vertical output stages.

   If vertical deflection is produced, the trouble is in the vertical oscillator. Make voltage and resistance checks in the vertical oscillator stage to locate the defective component.

EXCEPTIONS FOR TRANSISTORIZED SETS

Do not use the VERT GRID DRIVE signal in transistorized circuits. SOLID STATE SWEEP DRIVE output signal and its use for vertical deflection circuits is illustrated on page 37 & 38. Reference may also be made to figure 44b and the condensed procedure "No vert sweep, solid state sets" on page 73.

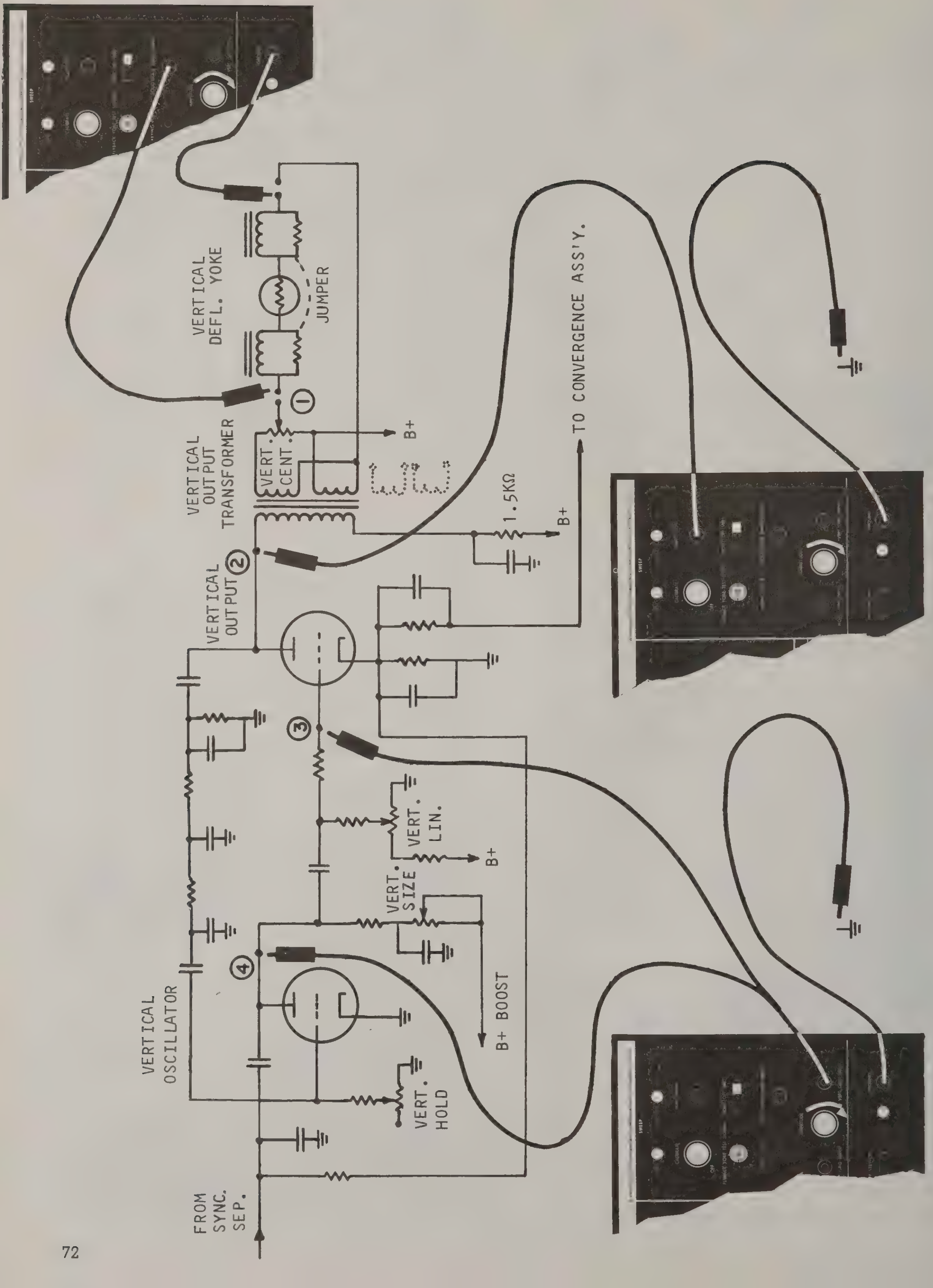
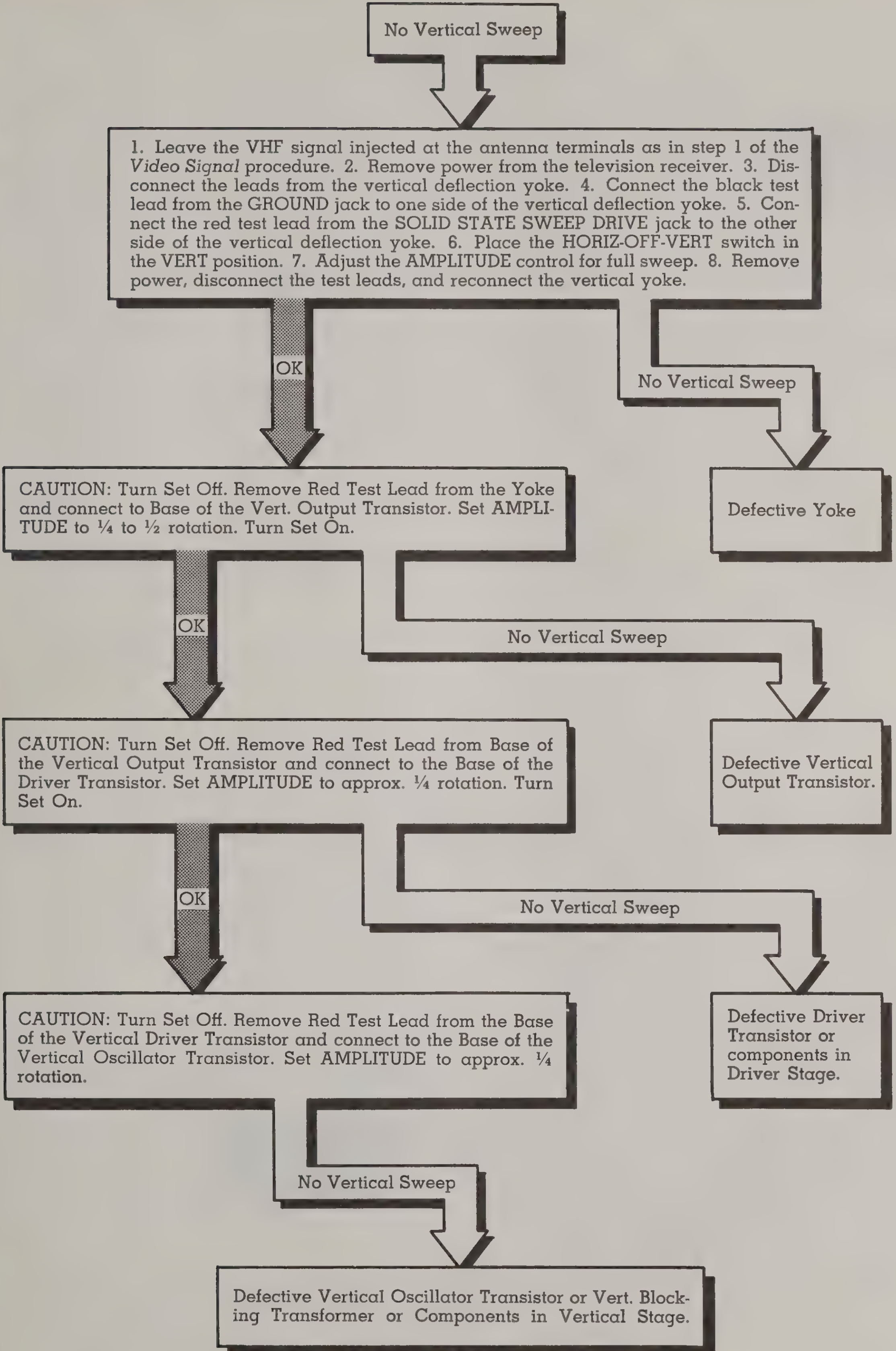


Figure 44a. Vertical Sweep Circuit Schematic Diagram



No Vertical Sweep

1. Leave the VHF signal injected at the antenna terminals as in step 1 of the *Video Signal* procedure. 2. Remove power from the television receiver. 3. Disconnect the leads from the vertical deflection yoke. 4. Connect the black test lead from the GROUND jack to one side of the vertical deflection yoke. 5. Connect the red test lead from the SOLID STATE SWEEP DRIVE jack to the other side of the vertical deflection yoke. 6. Place the HORIZ-OFF-VERT switch in the VERT position. 7. Adjust the AMPLITUDE control for full sweep. 8. Remove power, disconnect the test leads, and reconnect the vertical yoke.

Defective Yoke

CAUTION: Turn Set Off. Remove Red Test Lead from the Yoke and connect to Base of the Vert. Output Transistor. Set AMPLITUDE to ¼ to ½ rotation. Turn Set On.

Defective Vertical Output Transistor.

CAUTION: Turn Set Off. Remove Red Test Lead from Base of the Vertical Output Transistor and connect to the Base of the Driver Transistor. Set AMPLITUDE to approx. ¼ rotation. Turn Set On.

Defective Driver Transistor or components in Driver Stage.

CAUTION: Turn Set Off. Remove Red Test Lead from the Base of the Vertical Driver Transistor and connect to the Base of the Vertical Oscillator Transistor. Set AMPLITUDE to approx. ¼ rotation.

Defective Vertical Oscillator Transistor or Vert. Blocking Transformer or Components in Vertical Stage.

Condensed Troubleshooting Procedure No Vertical Sweep. Solid State Sets See Page 37.

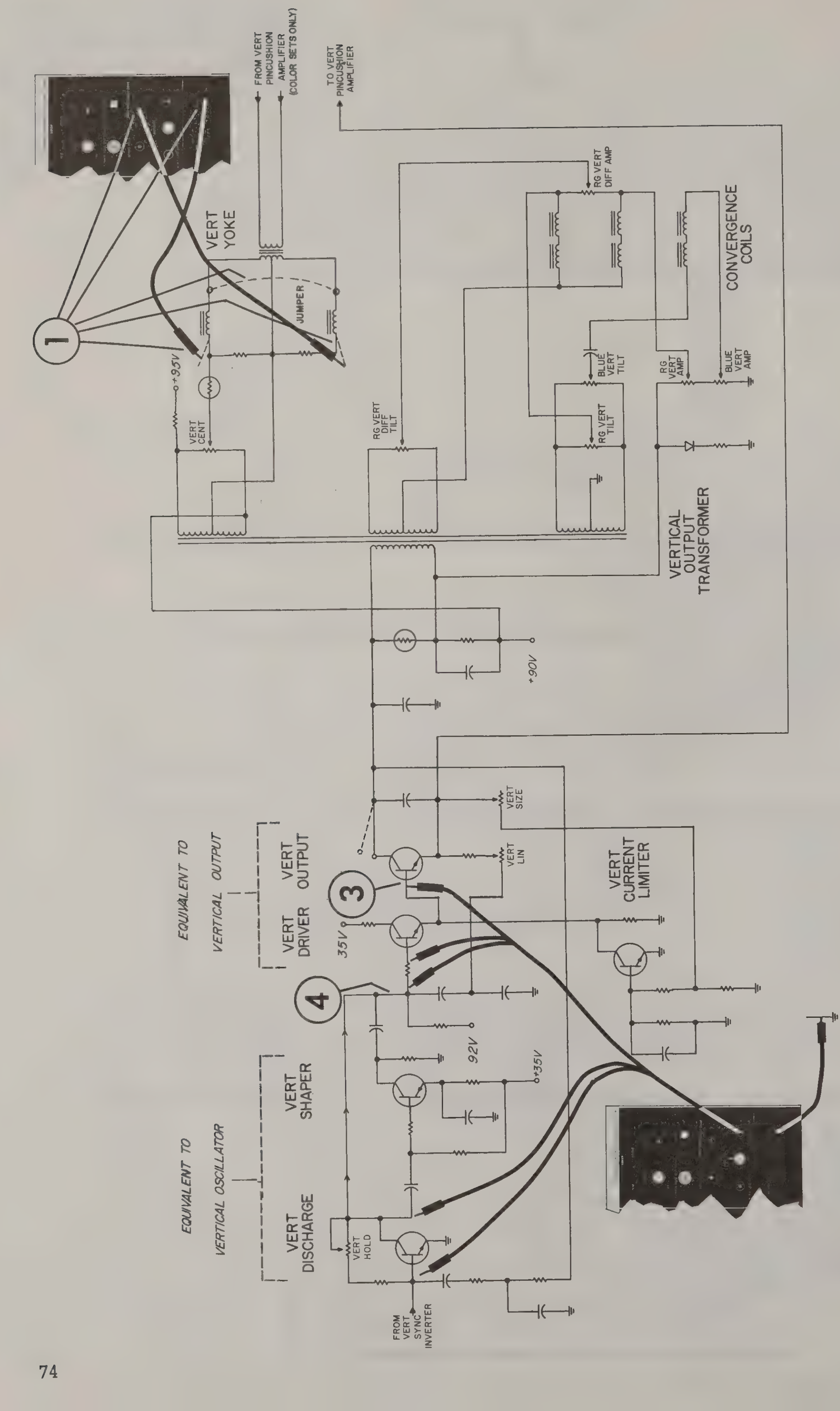


Figure 44b. Vertical Sweep Schematic Diagram

E. NO VIDEO—SOUND NORMAL

(See Figure 45)

This symptom is normally caused by a defective video amplifier or a bad picture tube. Because the sound and video separation point varies from set to set, it is also possible that the video detector stage is at fault. In other sets, only the final video amplifier could produce the symptoms. This procedure will locate the defect no matter where the sound and video separation occurs.

1. Inject maximum VIDEO test signal into the input of the final video amplifier. For complete procedures, refer to the *Video Signal* portion of the *Typical Troubleshooting Procedure.*

   If no video is produced on the picture tube, the trouble lies between the input of the final video amplifier and the picture tube. Go to step 2 for additional isolation procedures.

   If video is produced (probably out of sync), the trouble lies before the final video amplifier stage. Go to step 4.

2. Inject maximum SYNC signal directly to the picture tube. Refer to steps 11 through 17 of the *Sync Signal* portion of the *Typical Operating Procedure* for correct procedures and an explanation of results. Be sure to turn the vertical hold control on the television receiver to roll the picture.

   If no diagonal bars are seen (do not expect test pattern video), the picture tube is defective or the circuit is shorted to ground. Check for shorts.

   If diagonal bars are seen, the picture tube is proven capable of displaying video. Go to step 3.

3. Inject maximum SYNC signal at each series component from the picture tube to the output of the final video amplifier. If diagonal bars are not displayed for all injection points, check to see at which component the display is lost.

   If diagonal bars are still displayed with signal injected at the output of the final video amplifier stage, the stage is inoperative. Make voltage and resistance checks to find the defect.

4. Inject maximum VIDEO signal at the output of preceding amplifier stages. If no video is displayed on the picture tube, check the coupling components between the 1st and final video amplifier stages. If video is displayed, go to step 5.

5. Inject medium amplitude VIDEO signal at the input of the 1st video amplifier stage. If no video is displayed on the picture tube, the 1st video amplifier is inoperative. Make voltage and resistance checks to locate the defective part.

   If video is displayed, sound and video separation occur ahead of the video detector. The trouble will be located if you follow the "No Video—No Sound" *Troubleshooting Procedure.*

EXCEPTIONS FOR TRANSISTORIZED SETS

None

F. NO VIDEO—NO SOUND

(See Figure 46)

This symptom is caused by a malfunction between the antenna terminals and the point where video and sound are separated. This normally includes the tuner, rf amplifier, oscillator, mixer, i-f amplifiers, and the video detector. The following procedure will isolate the trouble:

1. Inject an i-f test signal into the input of the 3rd i-f amplifier. If no test pattern is displayed, or is unusually weak, the i-f stage or detector is defective. Make voltage and resistance checks as required to isolate the defective component.

   If video is displayed, the trouble lies toward the antenna. Go to step 2.

2. Move the i-f test signal to the input of the 2nd i-f amplifier. Measure the gain of the amplifier (procedures are given in the *IF Signal* portion of the *Typical Operating Procedure).* If no test pattern is displayed or gain is unusually low, the 2nd i-f amplifier stage is defective. Inject the i-f signal at each component that is in series with the signal path to locate the point where signal is lost. Make voltage and resistance checks to isolate the defective component.

   If video is displayed, the stage is good. Go to step 3.

3. Repeat the procedures of step 2, but this time injecting the signal at the input of the 1st i-f amplifier.

   If video is displayed, the stage is good. Go to step 4.

4. If the test pattern is still displayed with the i-f signal injected at the 1st i-f amplifier, the trouble lies in the rf amplifier, oscillator, or mixer circuit. To test the mixer, inject signal into the input of the mixer. If the mixer is operating, the signal will be passed and the test pattern will again be displayed. If defective, no test pattern will be seen. However, the mixer may pass the i-f signal even if it is not operating.

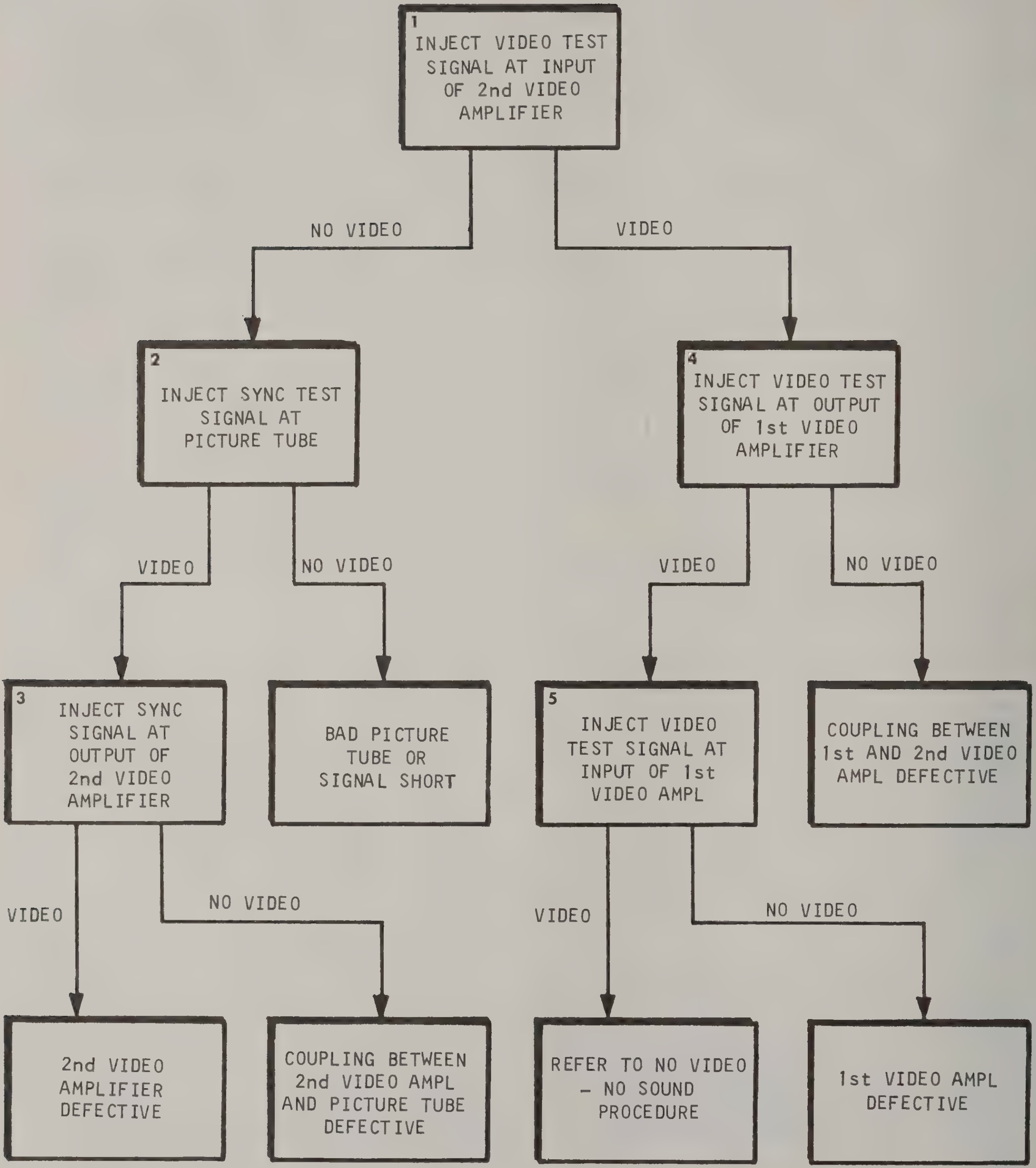
5. To test the vhf oscillator, inject a vhf test signal into the input of the mixer. If the oscillator is operating, and on the proper frequency, the injected signal and oscillator signal will mix to produce the i-f signal and the test pattern will be displayed. If the oscillator or mixer is defective, no test pattern will be seen.

6. If the mixer and oscillator are good, the trouble is in the rf amplifier or tuner. Inject the vhf test signal at various points in the circuit to localize the malfunction. Always inject a vhf signal on the same channel to which the television receiver is tuned. Try several channels.

7. If there is no video and no sound on uhf channels only. the trouble is in the uhf oscillator, uhf mixer, or uhf position of the channel selector.

EXCEPTIONS FOR TRANSISTORIZED SETS

None


1
INJECT VIDEO TEST SIGNAL AT INPUT OF 2nd VIDEO AMPLIFIER
NO VIDEO
VIDEO
2
INJECT SYNC TEST SIGNAL AT PICTURE TUBE
4
INJECT VIDEO TEST SIGNAL AT OUTPUT OF 1st VIDEO AMPLIFIER
VIDEO
NO VIDEO
VIDEO
NO VIDEO
3
INJECT SYNC SIGNAL AT OUTPUT OF 2nd VIDEO AMPLIFIER
BAD PICTURE TUBE OR SIGNAL SHORT
5
INJECT VIDEO TEST SIGNAL AT INPUT OF 1st VIDEO AMPL
COUPLING BETWEEN 1st AND 2nd VIDEO AMPL DEFECTIVE
VIDEO
NO VIDEO
VIDEO
NO VIDEO
2nd VIDEO AMPLIFIER DEFECTIVE
COUPLING BETWEEN 2nd VIDEO AMPL AND PICTURE TUBE DEFECTIVE
REFER TO NO VIDEO - NO SOUND PROCEDURE
1st VIDEO AMPL DEFECTIVE

Condensed Troubleshooting Procedure—NO VIDEO—SOUND NORMAL (See Figure 45)

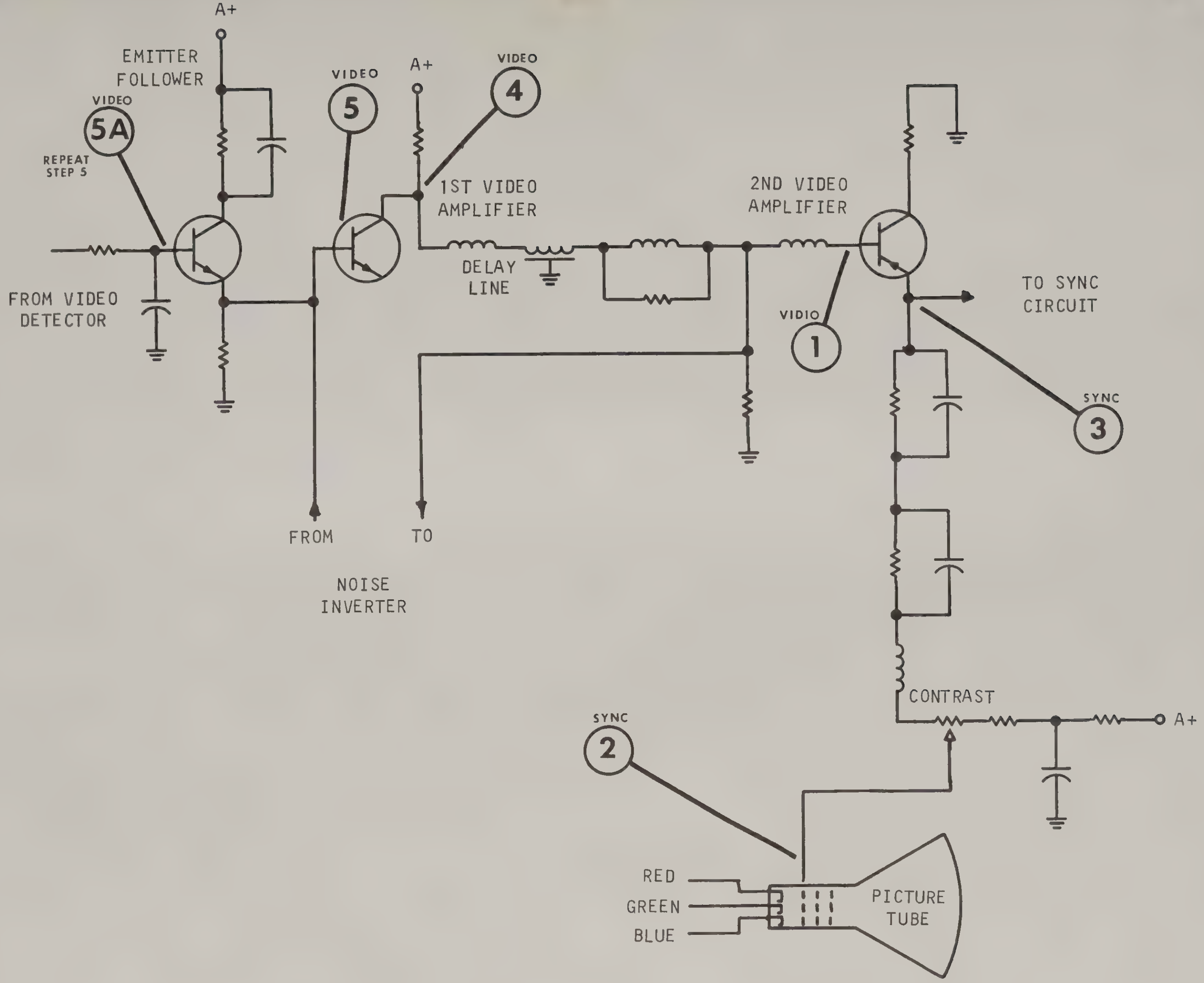
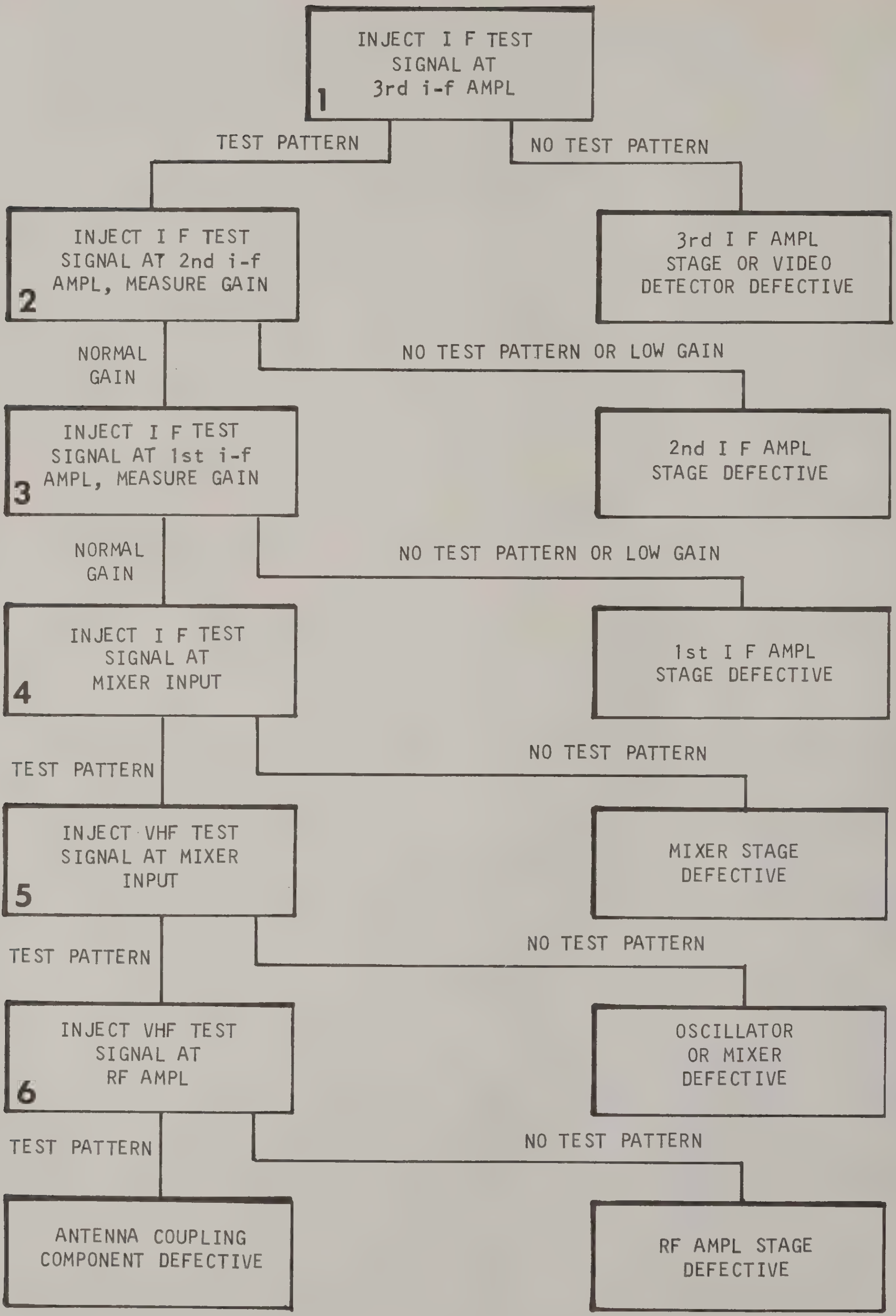


Figure 45. Transistorized Video Amplifier Circuits Schematic Diagram


INJECT I F TEST SIGNAL AT 3rd i-f AMPL
1
TEST PATTERN
NO TEST PATTERN
INJECT I F TEST SIGNAL AT 2nd i-f AMPL, MEASURE GAIN
2
3rd I F AMPL STAGE OR VIDEO DETECTOR DEFECTIVE
NORMAL GAIN
NO TEST PATTERN OR LOW GAIN
INJECT I F TEST SIGNAL AT 1st i-f AMPL, MEASURE GAIN
3
2nd I F AMPL STAGE DEFECTIVE
NORMAL GAIN
NO TEST PATTERN OR LOW GAIN
INJECT I F TEST SIGNAL AT MIXER INPUT
4
1st I F AMPL STAGE DEFECTIVE
TEST PATTERN
NO TEST PATTERN
INJECT VHF TEST SIGNAL AT MIXER INPUT
5
MIXER STAGE DEFECTIVE
TEST PATTERN
NO TEST PATTERN
INJECT VHF TEST SIGNAL AT RF AMPL
6
OSCILLATOR OR MIXER DEFECTIVE
TEST PATTERN
NO TEST PATTERN
ANTENNA COUPLING COMPONENT DEFECTIVE
RF AMPL STAGE DEFECTIVE

Condensed Troubleshooting Procedure—NO VIDEO—NO SOUND (See Figure 46)

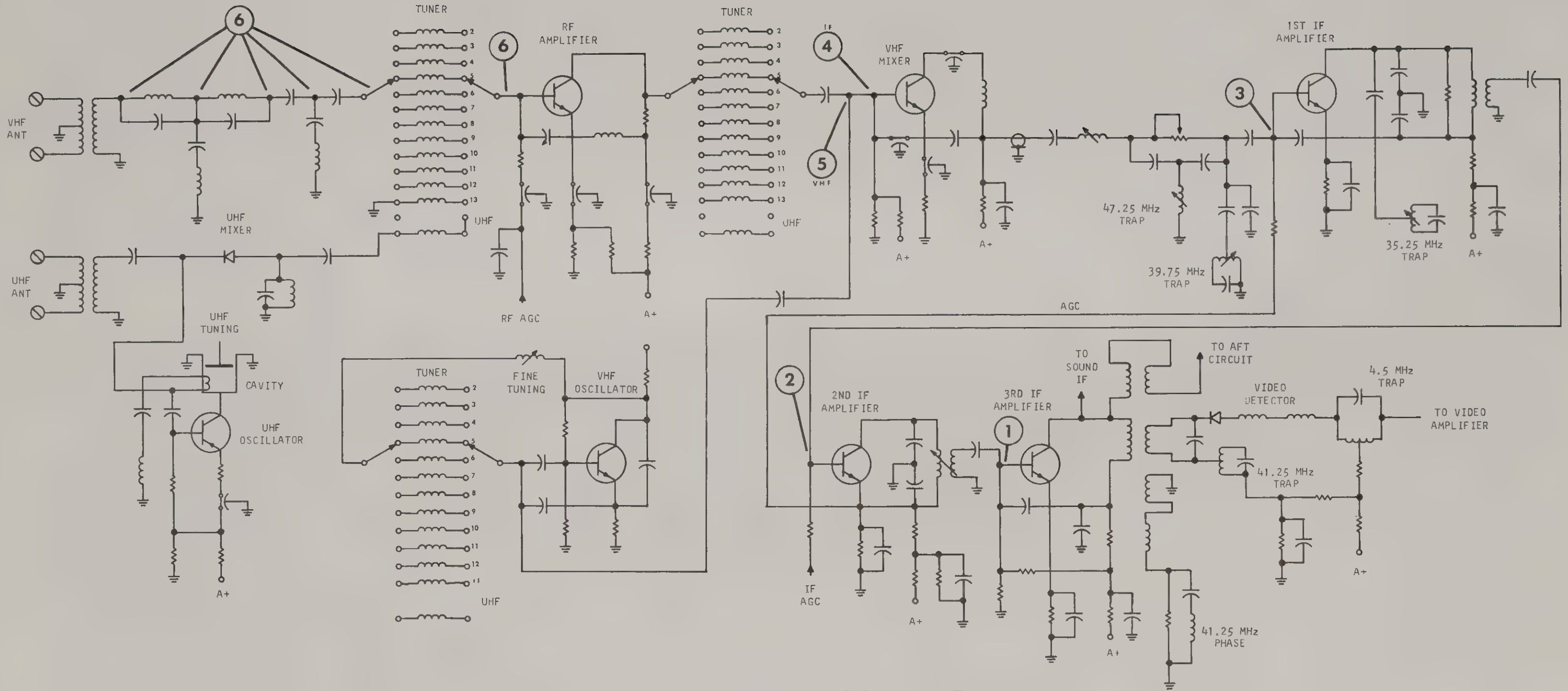


Figure 46. RF and IF Circuit Schematic Diagram

G. NO SOUND—VIDEO NORMAL

(See Figure 47)

This symptom is caused by a malfunction in the 4.5 MHz sound i-f stages, discriminator, audio amplifier, or speaker. Refer to the *4.5 MHz and 1 KHz Signal* portion of the *Typical Operating Procedure* for complete instructions on test connections and control settings on the TELEVISION ANALYST for isolating the trouble.

This troubleshooting procedure applies specifically to the circuit shown in Figure 47. However, the procedures are typical for all sound systems. Add or omit signal injection points as required so that a signal is injected to test each stage. Check the gain of each audio amplifier by listening for increased volume for each additional stage through which the 1 KHz tone passes.

EXCEPTIONS FOR TRANSISTORIZED SETS

None

H. NO VERTICAL SYNC

(See Figure 48)

With loss of vertical sync, the picture will roll no matter where the vert hold is set. This symptom is caused by the absence of vertical sync pulses at the vertical oscillator. Since the picture has horizontal sync, the trouble could lie only in a section of the sync separator stage or in a vertical sync amplifier stage (if used).

Inject the SYNC signal at the points indicated in Figure 48 or equivalent. The required signal may be of positive or negative polarity; try both. Remember to reverse polarity when changing the injection point from the output to the input of a stage. Inject sufficient signal to simulate normal operating values (refer to the schematic diagram of the television receiver for normal peak-to-peak signal values). If too much signal is required to restore proper operation, check for a component that has changed value drastically. Also check the gain of the sync separator stage. It may provide sufficient signal to provide horizontal sync but not vertical sync. Gain is checked by injecting minimum SYNC signal that will provide sync at the output and the input of the stage and noting the difference of the SYNC control setting.

Normal operation should be restored when the SYNC signal is injected at point 1. Move the point of injection toward the sync separator stage until vertical sync is lost. The defective component can then be easily checked with voltage or resistance measurements.

EXCEPTIONS FOR TRANSISTORIZED SETS

Refer to the schematic diagram of the television receiver and note the peak-to-peak sync voltage normally present in the circuit. Do not exceed this value when injecting signal from the TELEVISION ANALYST.

I. NO HORIZONTAL SYNC

(See Figure 49)

With this trouble, diagonal lines are seen on the screen but a picture cannot be locked in with the horizontal hold control on the television receiver. Since no picture is visible, presence or absence of vertical sync cannot be easily detected. However, this is of little consequence, because this troubleshooting procedure will locate the source of trouble for either case.

The symptom could be caused by a defective sync separator stage or the afc circuit which precedes the horizontal oscillator.

1. Inject SYNC signal at the sync input of the horizontal oscillator stage. It may require negative or positive polarity, try both. Refer to the schematic diagram of the television receiver that you are troubleshooting and adjust the SYNC control for typical level of sync pulse signal. Horizontal sync should be restored. Readjust the horizontal hold control if necessary.
2. Inject SYNC signal into the horizontal phase detector. If sync is not restored, this circuit is defective. If normal operation is restored, go to step 3.
3. Inject SYNC signal at the ouptut and input of the sync separator stage. Check the gain of the stage if it is operational. If no sync is obtained, this circuit is defective. If sync is restored, check coupling components into the sync separator stage.

EXCEPTIONS FOR TRANSISTORIZED SETS

Refer to the schematic diagram of the television receiver and note the peak-to-peak sync voltage normally present in the circuit. Do not exceed this value when injecting signal from the TELEVISION ANALYST.

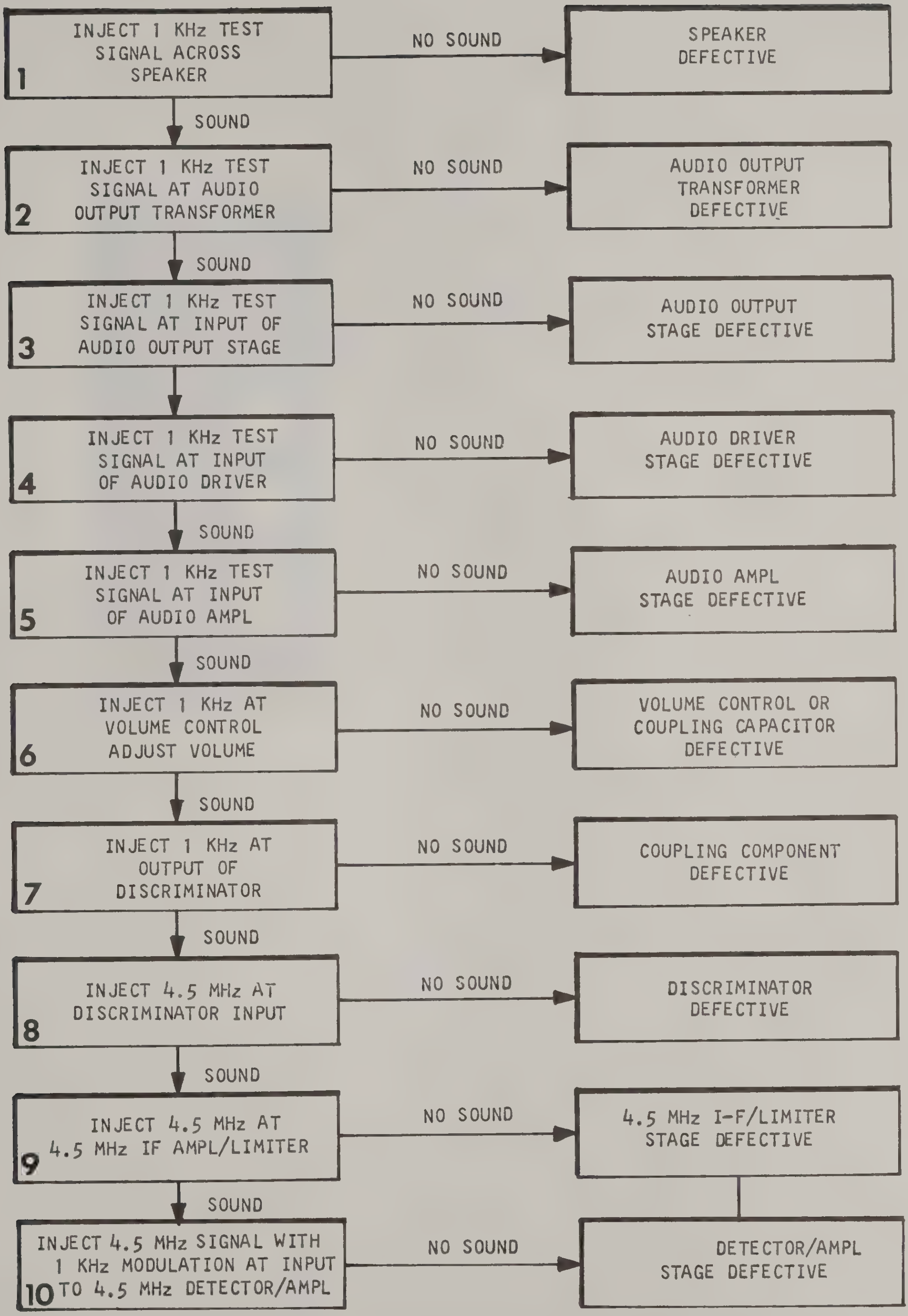
J. OVERLOADED VIDEO

(See Figure 50)

Overloaded video causes the picture to appear negative and out of sync at normal and high signal levels injected at the antenna terminals. Decrease the signal to a very low level and the normal test pattern will usually appear, accompanied by snow. This symptom is caused by an rf, i-f, or video amplifier that is overdriven, which results in clipping of the signal at normal and high signal levels. A defect in the agc (automatic gain control) section would produce such a symptom because it would allow the amplifiers to operate at maximum gain.

The first step of the procedure is to determine whether or not the trouble is definitely in the agc section.

1. Inject i-f signal into the 3rd i-f amplifier and set the RF ATTENUATOR control to 10. Normally, the agc section does not control the gain of the 3rd i-f amplifier. If the overloaded video symptom still appears, the trouble is not in the agc section. Inject VIDEO signal into each video amplifier stage and locate the defective stage. Make


1 INJECT 1 KHz TEST SIGNAL ACROSS SPEAKER
NO SOUND
SPEAKER DEFECTIVE
SOUND
2 INJECT 1 KHz TEST SIGNAL AT AUDIO OUTPUT TRANSFORMER
NO SOUND
AUDIO OUTPUT TRANSFORMER DEFECTIVE
SOUND
3 INJECT 1 KHz TEST SIGNAL AT INPUT OF AUDIO OUTPUT STAGE
NO SOUND
AUDIO OUTPUT STAGE DEFECTIVE
4 INJECT 1 KHz TEST SIGNAL AT INPUT OF AUDIO DRIVER
NO SOUND
AUDIO DRIVER STAGE DEFECTIVE
SOUND
5 INJECT 1 KHz TEST SIGNAL AT INPUT OF AUDIO AMPL
NO SOUND
AUDIO AMPL STAGE DEFECTIVE
SOUND
6 INJECT 1 KHz AT VOLUME CONTROL ADJUST VOLUME
NO SOUND
VOLUME CONTROL OR COUPLING CAPACITOR DEFECTIVE
SOUND
7 INJECT 1 KHz AT OUTPUT OF DISCRIMINATOR
NO SOUND
COUPLING COMPONENT DEFECTIVE
SOUND
8 INJECT 4.5 MHz AT DISCRIMINATOR INPUT
NO SOUND
DISCRIMINATOR DEFECTIVE
SOUND
9 INJECT 4.5 MHz AT 4.5 MHz IF AMPL/LIMITER
NO SOUND
4.5 MHz I-F/LIMITER STAGE DEFECTIVE
SOUND
10 INJECT 4.5 MHz SIGNAL WITH 1 KHz MODULATION AT INPUT TO 4.5 MHz DETECTOR/AMPL
NO SOUND
DETECTOR/AMPL STAGE DEFECTIVE

Condensed Troubleshooting Procedure—NO SOUND—VIDEO NORMAL (See Figure 47)

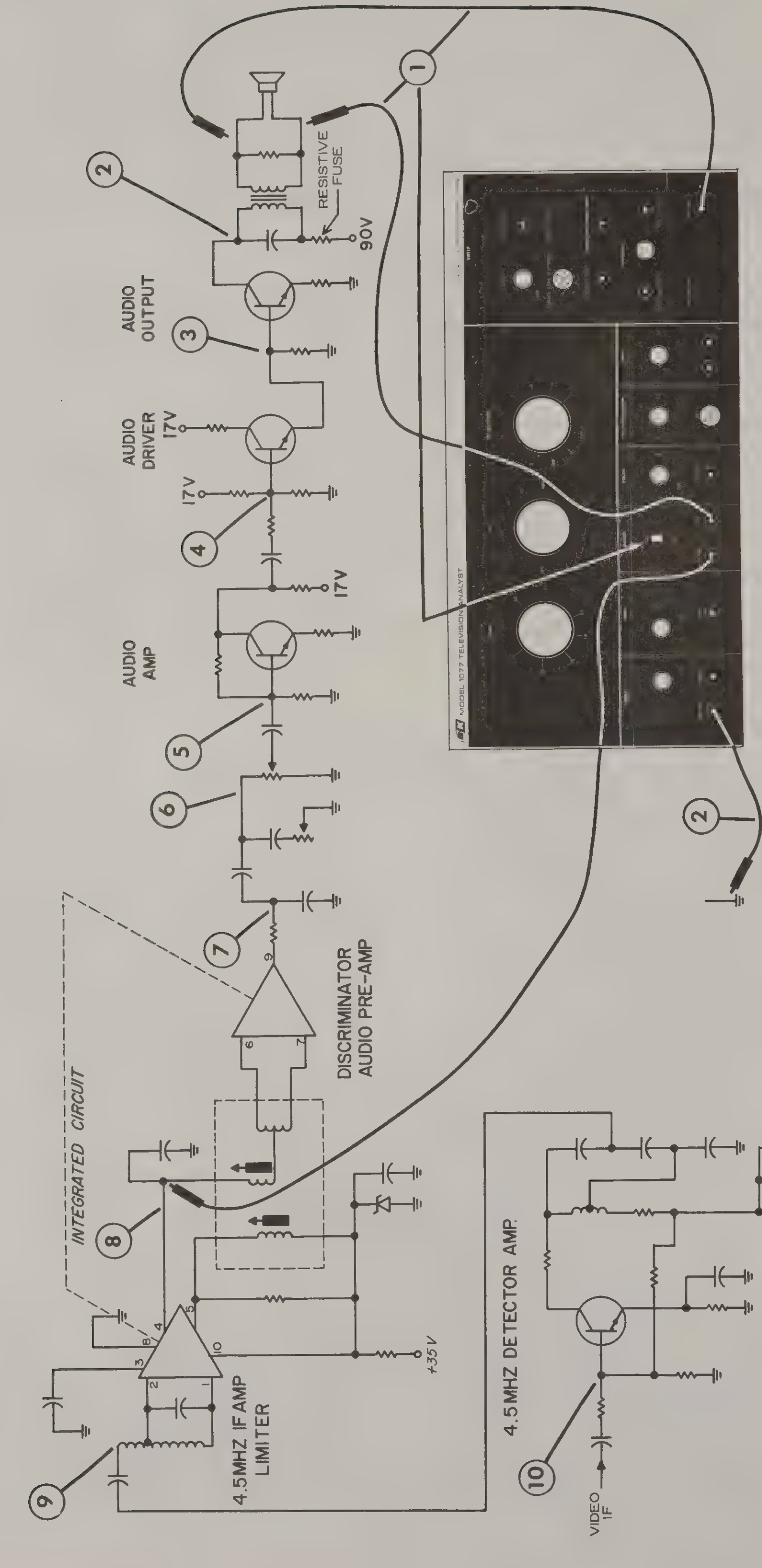


Figure 47. Sound Section Schematic Diagram

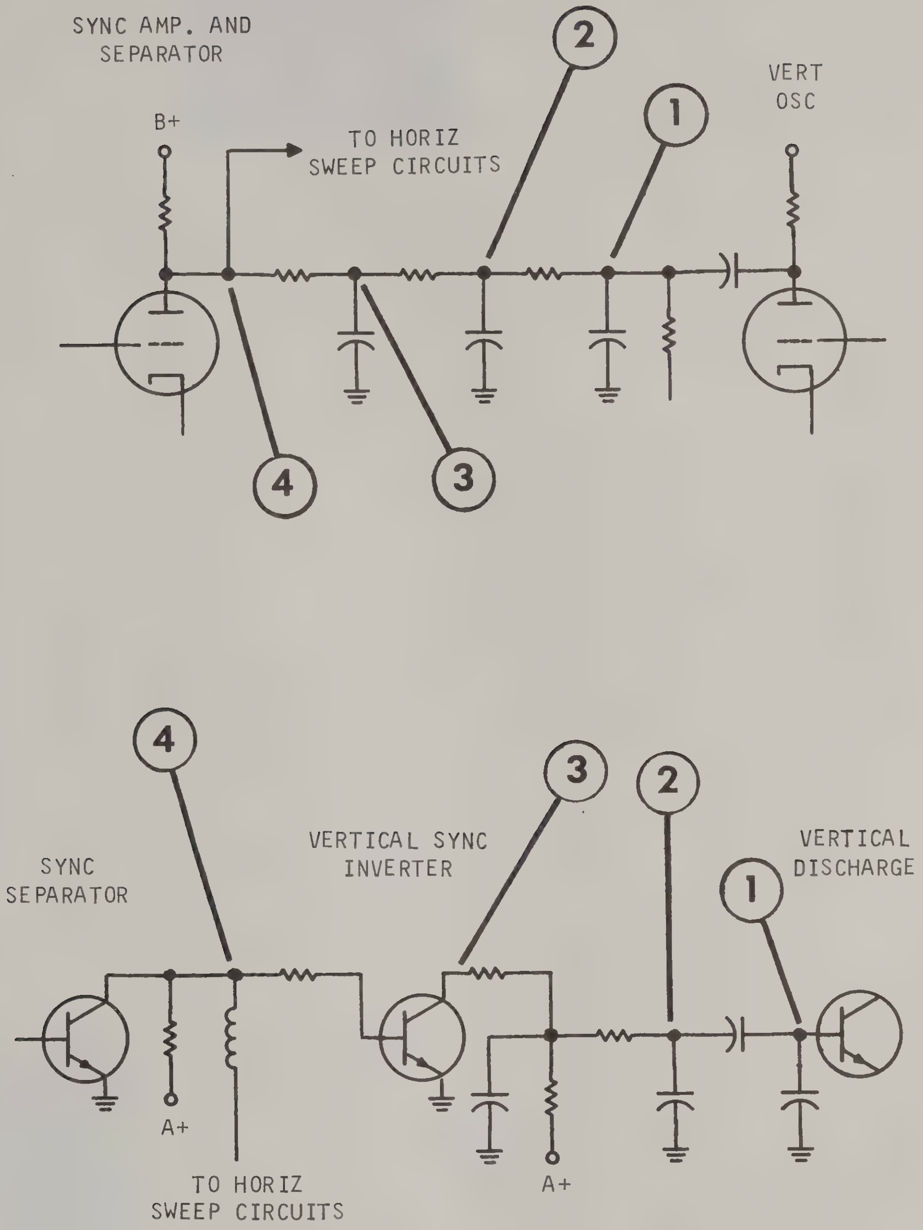


Figure 48. Two Types of Vertical Sync Circuits, Schematic Diagram

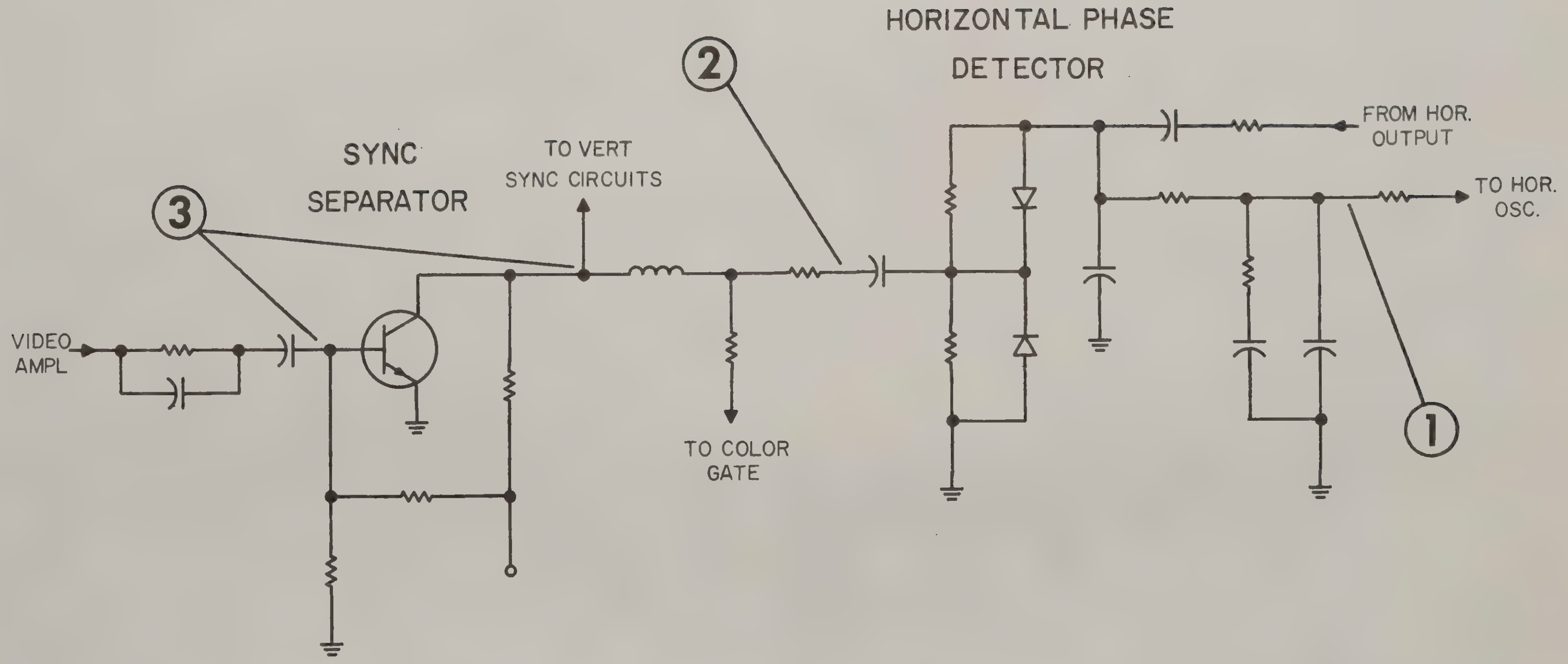


Figure 49. Horizontal Sync Circuit Schematic Diagram

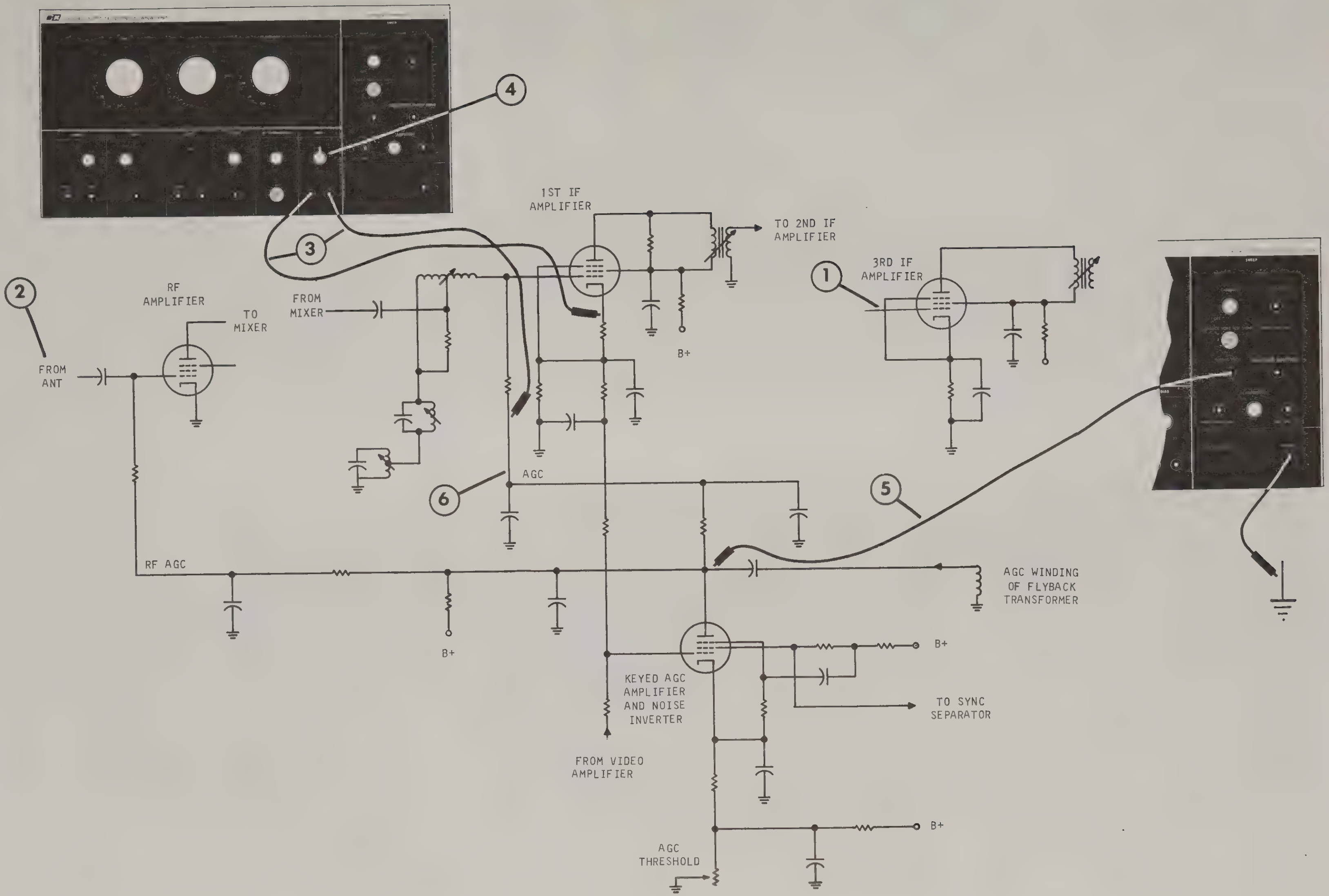


Figure 50. AGC Circuit Schematic Diagram

voltage and resistance checks in the defective stage to locate the defective part. Especially check for a leaky capacitor or changed resistor value that would shift the bias on the stage.

If a normal test pattern is displayed with the i-f signal injected at the 3rd i-f amplifier, it is probable that the trouble is located in the agc section, although not conclusive. Go to step 2.

2. Again inject vhf signal at the antenna terminals and adjust the RF ATTENUATOR control for the symptom of overloaded video.

3. Set the BIAS control to 0 (zero). Connect the bias test voltage to the agc line using the cathode of the 1st video IF amplifier (emitter if a transistor is used) as reference. Connect the polarity to provide negative bias for a vacuum tube or forward bias for a transistor.

4. Increase the BIAS control setting and observe the test pattern display. As the control is turned higher on vacuum tube circuits, the overloaded video symptom should diminish and normal operation should be restored. If turned further, the picture should dim then disappear as the tube is cut off.

   On transistorized circuits, the picture should be dim or cut off with the BIAS control set at 0. As the control is increased, normal operation should be restored, then the overloaded video symptom should return.

   If varying the BIAS control affects the picture as described, the trouble is definitely in the agc section. The amplifiers have demonstrated that they can be controlled if agc voltage is properly developed. The bias supply has such low impedance compared to the agc circuit that the TELEVISION ANALYST will "take over" and maintain complete control of the agc function. Go to step 5.

   If the overloaded video symptom continues to appear while the BIAS control is adjusted, either the trouble is unrelated to the agc section or the agc line is completely shorted. Go to step 6 for complete isolation procedures.

5. Remove the bias voltage connections and inject the KEYING PULSE output at the plate of the keyed agc amplifier. If this step produces normal operation, check for the trouble in the agc winding of the flyback transformer or the coupling components between the flyback transformer and the keyed agc amplifier.

   If overloaded video continues, check voltages and resistances of components that would disable the keyed agc amplifier stage.

6. Disconnect the grid (base of transistor) of the 2nd i-f amplifier from the agc circuit and connect the BIAS voltage source in its place (same as step 3). If there is a short in the agc circuit, it will now be disconnected from the amplifier circuit. Vary the BIAS control. If the BIAS control affects the picture as described in step 4, repeat this procedure for the 1st i-f amplifier and r-f amplifier stages. If the overloaded video symptom does not appear continuously at any of these stages, it is conclusive that the trouble is in the agc circuit. Disconnect the agc filter capacitors one at a time and repeat the test procedure (steps 3 and 4) until the defective capacitor is located.

   If the overloaded video symptom reappears and the BIAS control has no effect upon the picture in any of the stages (2nd i-f amplifier, 1st i-f amplifier or rf amplifier), check for a defective part in that stage. Be alert for a leaky capacitor that may shift the bias on the amplifier.

EXCEPTIONS FOR TRANSISTORIZED SETS

1. Do not exceed the asterisk (*) on the BIAS control setting.

2. Do not use the KEYING PULSE output. The SYNC output will provide sufficient pulse for most transistorized circuits. Check the schematic diagram of the television receiver for the required peak-to-peak voltage.

K. NO COLOR—BLACK AND WHITE NORMAL

(See Figure 51)

This symptom can be caused by a failure in the color i-f amplifiers, or the color killer. Locate the specific stage with the following procedure:

1. Inject maximum amplitude COLOR signal at the input of the color demodulators. It is very improbable that all demodulators have failed simultaneously, so we will assume that the trouble lies before the demodulators. If synchronized color is displayed, the color oscillator is operating. Go to step 2.

2. Inject maximum amplitude COLOR signal at the output of the 2nd color i-f amplifier.

   If no color is displayed, check the coupling components between the 2nd color i-f amplifier and the color demodulators. Use signal injection to isolate the defect to as small an area as possible.

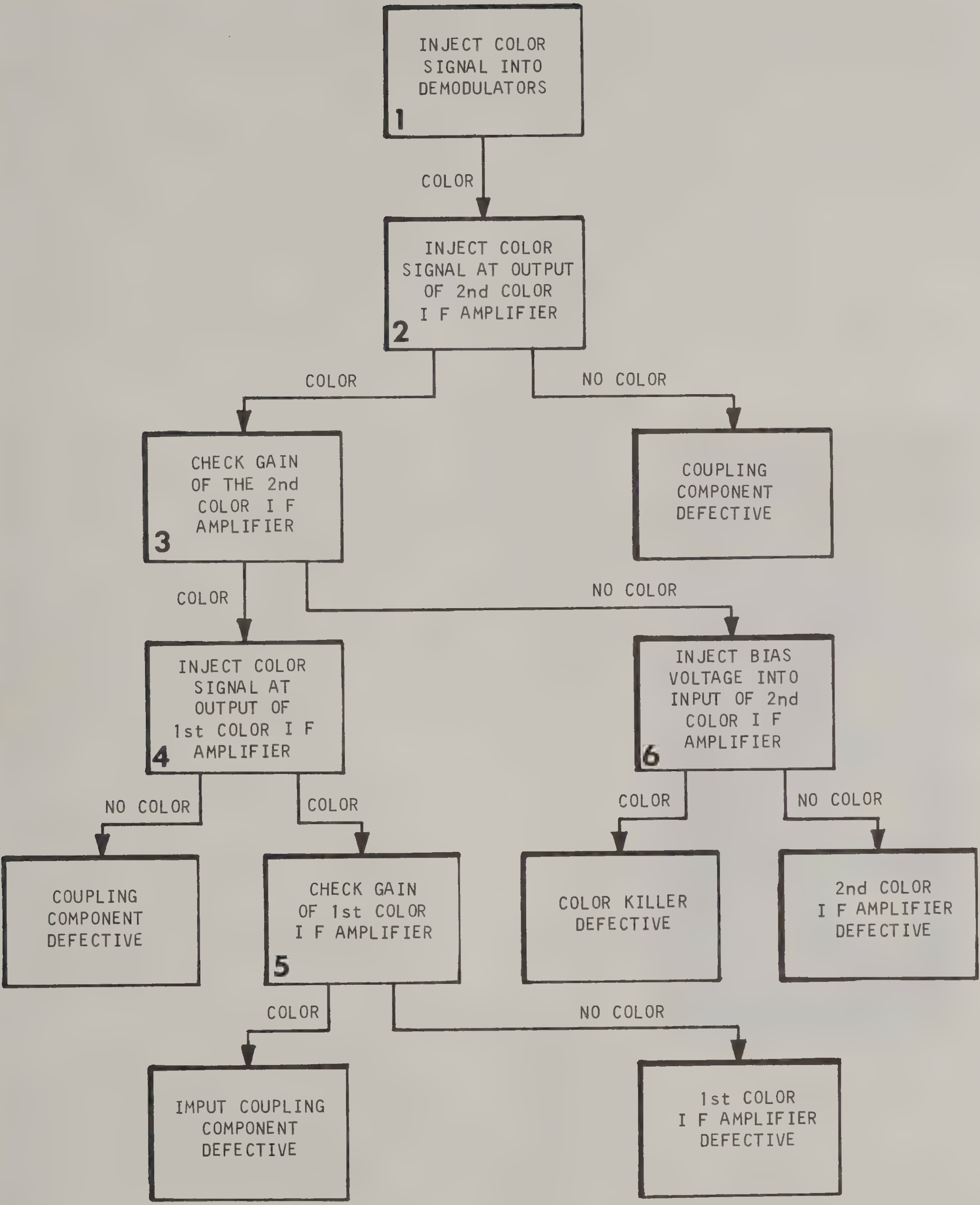
   If color is displayed, the coupling components are good. Go to step 3.

3. Check the gain of the 2nd color i-f amplifier by moving the signal injection point to the input of the stage and observing the difference in color intensity on the screen. If the amplifier is operating properly, the intensity of the color display should increase radically when the signal injection point is changed to the input of the stage.

   The relative amount of gain may be checked more accurately by reducing the COLOR control setting until color is barely perceptible with the color signal injected at the output of the stage, then moving the injection to the input of the stage and again reducing the COLOR control setting until color is barely perceptible.

   If gain is normal, go to step 4.

   If gain is low, or no color display is provided with signal injected at the input of the stage, the trouble could be in the 2nd color i-f amplifier or the color killer. Go to step 6 for isolation procedures.


INJECT COLOR SIGNAL INTO DEMODULATORS
1
COLOR
INJECT COLOR SIGNAL AT OUTPUT OF 2nd COLOR I F AMPLIFIER
2
COLOR
NO COLOR
CHECK GAIN OF THE 2nd COLOR I F AMPLIFIER
3
COUPLING COMPONENT DEFECTIVE
COLOR
NO COLOR
INJECT COLOR SIGNAL AT OUTPUT OF 1st COLOR I F AMPLIFIER
4
INJECT BIAS VOLTAGE INTO INPUT OF 2nd COLOR I F AMPLIFIER
6
NO COLOR
COLOR
COLOR
NO COLOR
COUPLING COMPONENT DEFECTIVE
CHECK GAIN OF 1st COLOR I F AMPLIFIER
5
COLOR KILLER DEFECTIVE
2nd COLOR I F AMPLIFIER DEFECTIVE
COLOR
NO COLOR
IMPUT COUPLING COMPONENT DEFECTIVE
1st COLOR I F AMPLIFIER DEFECTIVE

Condensed Troubleshooting Procedure—NO COLOR—BLACK AND WHITE NORMAL (See Figure 51)

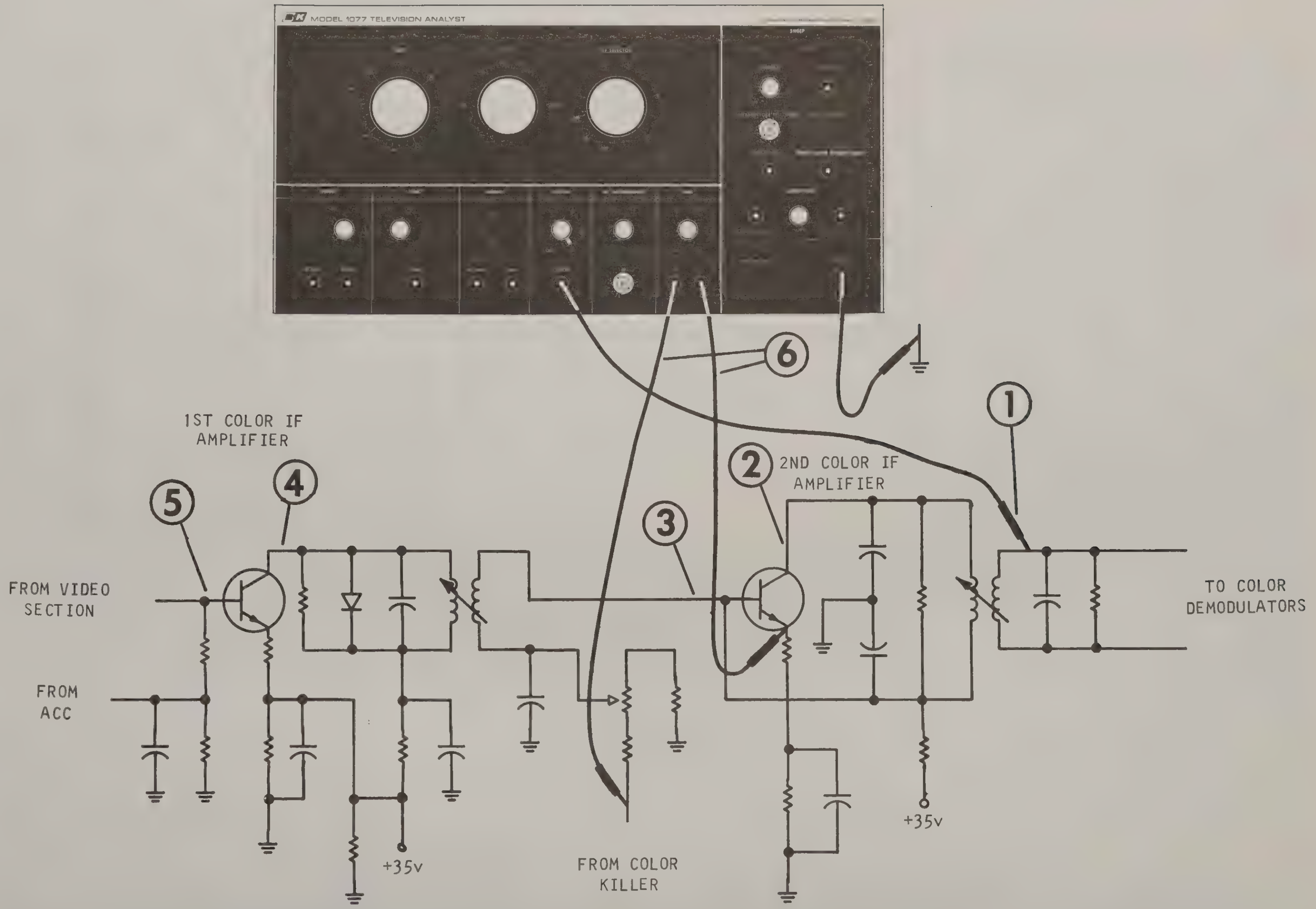


Figure 51. Color IF and Color Killer Schematic Diagram

4. Inject a medium amplitude COLOR signal at the output of the 1st color i-f amplifier. If no color is displayed, the coupling components between the 1st color i-f amplifier and the 2nd color i-f amplifier are defective.

   If color is displayed, the coupling components are good. Go to step 5.

5. Check the gain of the 1st color i-f amplifier. Refer to step 3 for procedures.

   If gain is normal, check the coupling components between the video amplifier section and the 1st color i-f amplifier.

   If gain is low or color is not displayed, the 1st color i-f amplifier is inoperative. Locate the component that has disabled the stage.

6. The procedures in this step isolate a trouble to the 2nd color i-f amplifier or the color killer. The dc output of the color killer normally keeps the amplifier cut off until a color signal is received. If the color killer is defective, the amplifier will stay cut off all the time.

   Leave the vhf signal injected at the antenna terminals and with the COLOR control on. Also connect the BIAS power supply to the input of the 2nd color i-f amplifier and adjust the BIAS control to assure that the amplifier is not cut off.

   If the color display is restored, the color killer is the defective stage.

   If no color can be displayed, the 2nd color i-f amplifier is the defective stage.

EXCEPTIONS FOR TRANSISTORIZED SETS

Do not exceed the asterisk (*) on the BIAS control setting.

L. ONE COLOR ABSENT

(See Figure 52)

With this symptom, all color will be missing on one of the primary color bars (red = bar #3, blue = bar #6, green = bar #10) when the hue control is adjusted to obtain correct color on one of the other primary color bars. All other color bars will probably be of incorrect colors because color mixing cannot be performed when a primary color is missing.

The symptom would be caused by an inoperative demodulator, color amplifier, or color gun in the picture tube. Procedures are virtually the same for red, blue, or green color circuits. For simplicity, the following procedures use the red color circuit only, but a blue or green circuit can be substituted.

1. Remove the antenna terminal connections and either 1st or 2nd video amplifier.

2. Inject maximum amplitude SYNC signal (+) at the red gun of the picture tube. We are not concerned with a test pattern or discernible picture. All we want to check is the ability to produce red on the screen of the picture tube. It may be necessary to adjust HORIZ HOLD to produce visible pattern, the result should be 3-10 diagonal bars.

   If red lines are seen on the screen, the red gun of the picture tube is good. Go to step 3.

   If no red color is displayed, the red gun of the picture tube is defective.

3. Inject a maximum amplitude video signal at the input of the red output amplifier. Try both the positive and negative polarities. If red video is displayed, this stage is good. Go to step 4.

   If no red color is displayed, inject the SYNC signal at various points in the output of the stage to isolate the trouble to as small an area as possible.

4. If the television receiver has a red pre-driver or equivalent stage such as shown in Figure 52, inject a VIDEO signal at the input to that stage.

   If red video is displayed, this stage is good. Go to step 5.

   If no red color is displayed, this stage is inoperative.

5. Inject a VIDEO signal at the output of the red demodulator. If red video is displayed, the trouble is in the demodulator.

   If red color is not displayed, check the coupling components between the demodulator and red amplifier.

EXCEPTIONS FOR TRANSISTORIZED SETS

None.

M. NO COLOR SYNC

(See Figure 53)

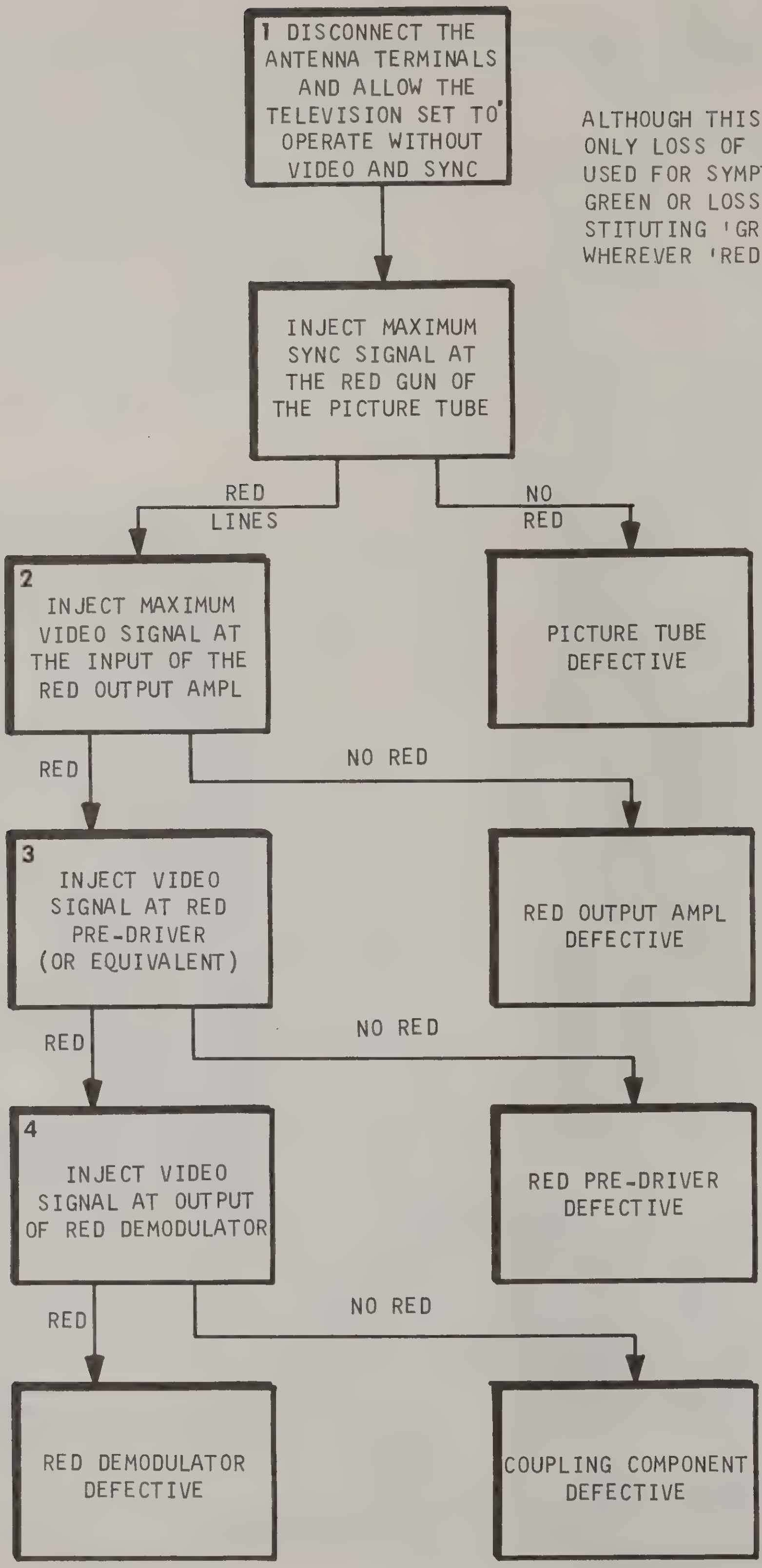
With this symptom the color bars are not in the proper sequence or colors are erratic and confetti-like at each color bar. The symptom is caused by loss of synchronization to the 3.58 MHz oscillator by a defective burst amplifier, phase detector, reactance control stage, or oscillator. These stages control the phase of the oscillator. The TELEVISION ANALYST can be used to isolate troubles in these stages as follows:

1. Inject bias voltage at the input of the reactance modulator and vary the BIAS control setting. If the reactance modulator stage is good, the hue of the color bars should vary as the BIAS control is adjusted and it should be possible to adjust for proper color display. If varying the BIAS control has no effect, the reactance modulator or oscillator stage is defective.

2. Set the COLOR control to 1 (on) and inject COLOR signal into the burst amplifier. If the burst amplifier and phase detector are good, injection of the signal should restore color sync. If either is defective, the symptom will remain unchanged.

EXCEPTIONS FOR TRANSISTORIZED SETS

Do not exceed asterisk (*) on the BIAS control setting.


1 DISCONNECT THE ANTENNA TERMINALS AND ALLOW THE TELEVISION SET TO OPERATE WITHOUT VIDEO AND SYNC
INJECT MAXIMUM SYNC SIGNAL AT THE RED GUN OF THE PICTURE TUBE
RED LINES
NO RED
2 INJECT MAXIMUM VIDEO SIGNAL AT THE INPUT OF THE RED OUTPUT AMPL
PICTURE TUBE DEFECTIVE
RED
NO RED
3 INJECT VIDEO SIGNAL AT RED PRE-DRIVER (OR EQUIVALENT)
RED OUTPUT AMPL DEFECTIVE
RED
NO RED
4 INJECT VIDEO SIGNAL AT OUTPUT OF RED DEMODULATOR
RED PRE-DRIVER DEFECTIVE
RED
NO RED
RED DEMODULATOR DEFECTIVE
COUPLING COMPONENT DEFECTIVE

ALTHOUGH THIS CHART MENTIONS ONLY LOSS OF RED, IT CAN BE USED FOR SYMPTOMS OF LOSS OF GREEN OR LOSS OF BLUE BY SUBSTITUTING 'GREEN' OR 'BLUE' WHEREVER 'RED' IS MENTIONED.

Condensed Troubleshooting Procedure—ONE COLOR ABSENT (See Figure 52)

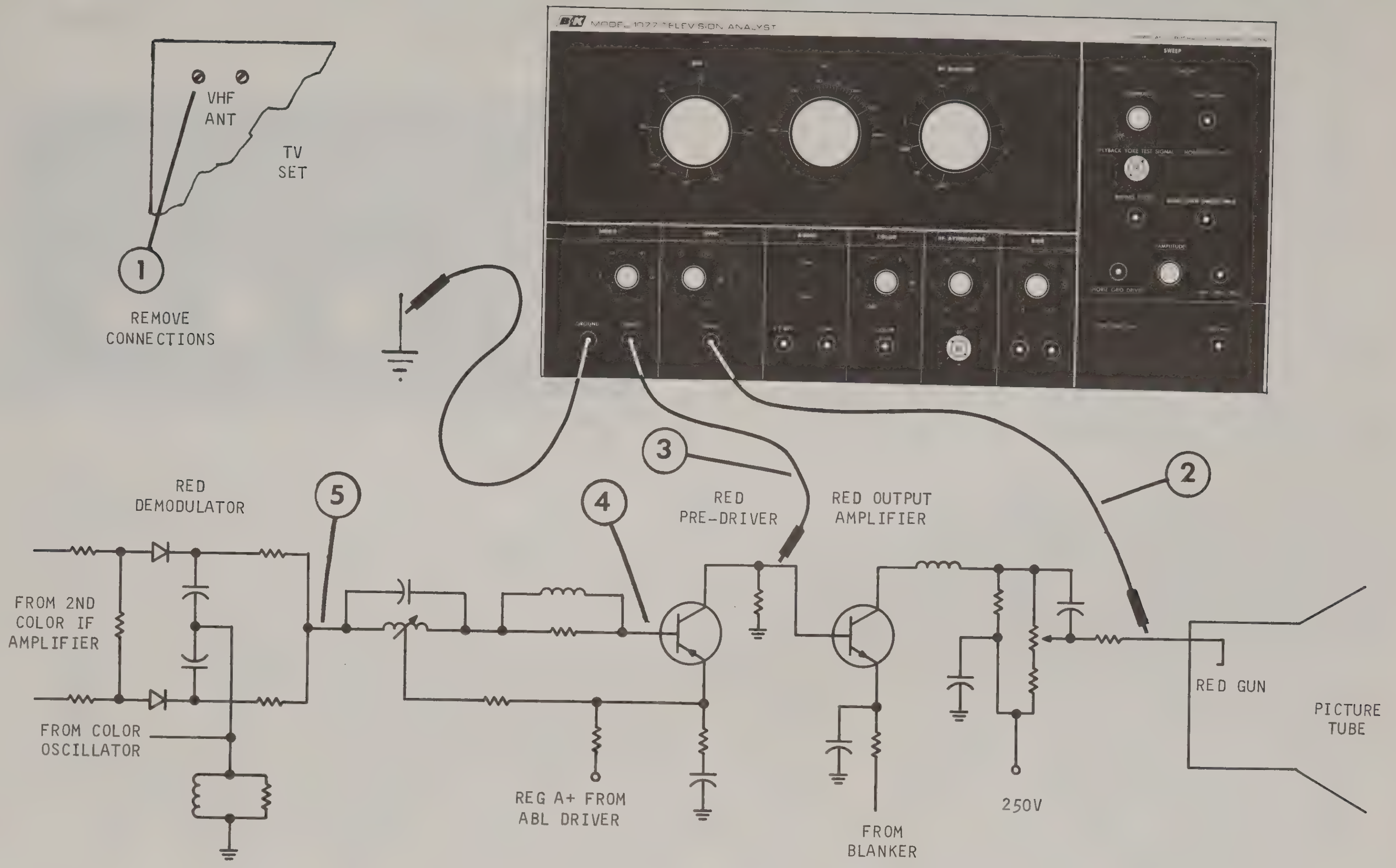


Figure 52. Red Demodulator and Amplifier Schematic Diagram

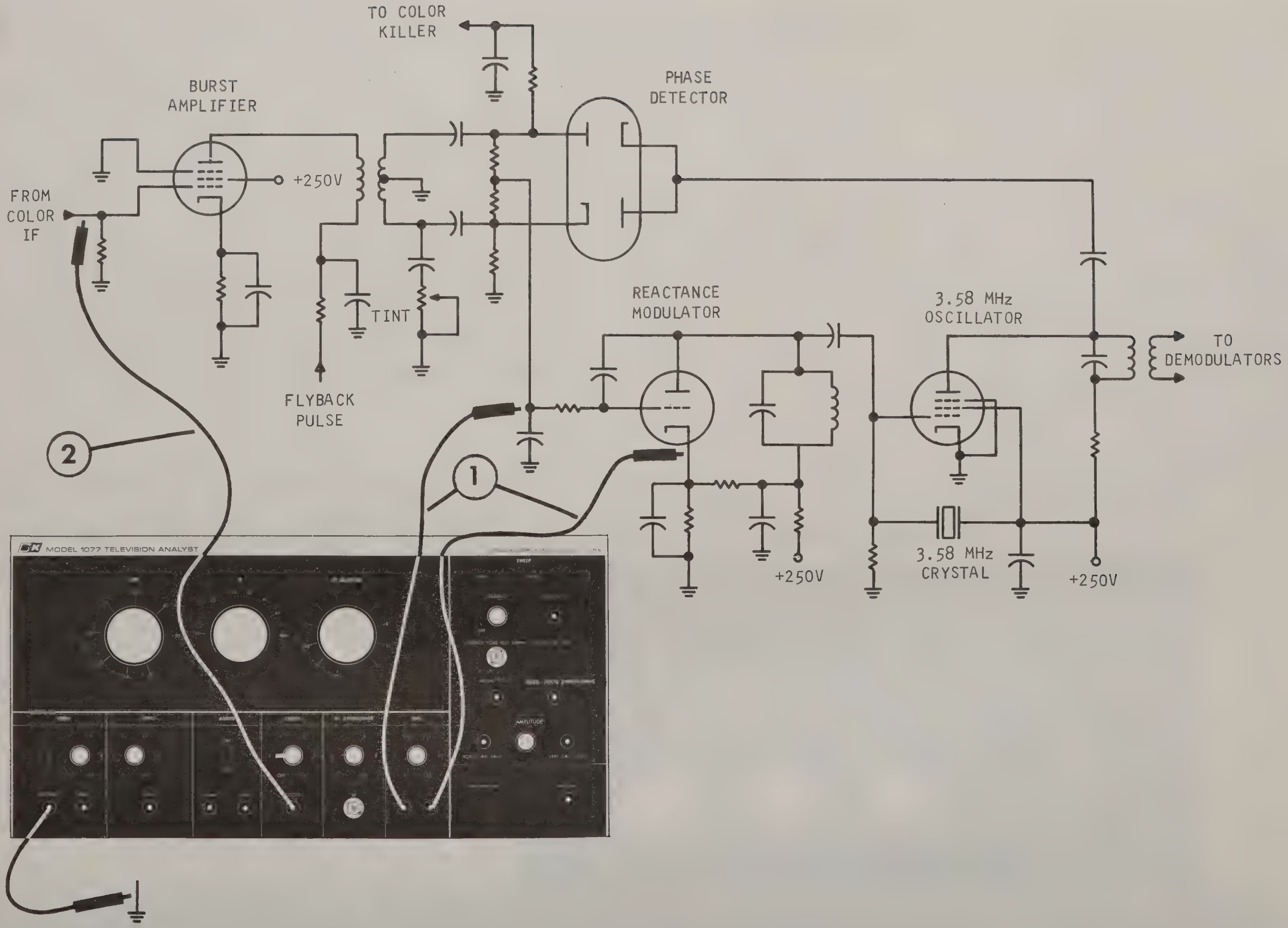


Figure 53. Color Sync Circuit Schematic Diagram

N. INTERMITTENT TROUBLES

Intermittent troubles are the most difficult of all to isolate. The symptom will show up after the television receiver has been in operation, last a while, then disappear for a time. There is no set pattern to the rapidity with which the symptom will appear, nor any guarantee that it will remain equally long when it does show up again. This is the reason intermittent troubles are so hard to track down. Also, it is not unusual for an intermittent trouble to disappear just as the serviceman starts to check the circuit. Because intermittent troubles normally take so much time to locate, the television serviceman often suffers a loss rather than making a profit on the repair. The TELEVISION ANALYST can drastically cut servicing time and convert such losses to profit because it is the ideal instrument for locating intermittent troubles.

During the short duration of the intermittent trouble, the symptom will fall into one of the categories previously given. This alone isolates the trouble to a few stages in a specific section of the television receiver. The TELEVISION ANALYST can be used to inject signals into these stages, and by a process of elimination, the trouble will be narrowed down to one stage.

With intermittent troubles, most technicians prefer to start in the suspected area nearest the antenna and work toward the picture tube (or speaker for audio troubles). Signal is injected from the TELEVISION ANALYST and the television receiver is allowed to operate until the symptom reoccurs. The technician can be servicing another set while waiting for the intermittence to recur.

B&K offers additional test equipment that can be used advantageously with the TELEVISION ANALYST for locating intermittent troubles. The B&K Diagnostic Oscilloscope includes an intermittent analyzer circuit that indicates any change in signal level. Of course, a constant signal source is required such as that from the TELEVISION ANALYST. The Remote Alarm is an accessory for the oscilloscope that provides a flashing light and buzzer alarm whenever the signal level changes. The alarm indications continue until reset. These items of equipment free the technician from closely monitoring the set while waiting for the intermittent trouble to recur.

When the intermittent symptom appears, the point of signal injection is moved to the next stage and the procedure repeated. The last stage at which the intermittent symptom occurred is the defective stage.

Once the defective stage is located, it may be wise to replace components one at a time until the defective part is found. After each part is replaced, inject signal and recheck for the intermittent symptom. When the intermittent symptom ceases, the defective part has been located and replaced.

A. CENTERING, SIZE, AND LINEARITY

(See Figure 54)

It is difficult to adjust centering, size, and linearity without the aid of a test pattern such as the TELEVISION ANALYST provides. Using the picture that is normally transmitted by a station, no image remains fixed long enough to permit complete adjustment. Furthermore, any image not containing a fairly large circular pattern will not provide enough visible markings to establish true linearity. If this method is attempted, the non-linearity will be apparent when a circular object finally does appear on the screen.

The test pattern produced by the TELEVISION ANALYST is the ideal signal source for making centering, size, and linearity adjustments. The pattern is unchanged over the duration of the adjustment sequence, it has a large outer circle as a standard for making size adjustments, and it has a number of smaller circles which should all be perfectly round when the linearity of the deflection is properly adjusted.

1. Measure from opposite diagonal corners of the picture tube screen and mark the physical center of the screen with a grease pencil or similar marker.
2. Insert the test pattern into the TELEVISION ANALYST and inject VHF signal at the vhf antenna terminals of the television receiver. Adjust the controls of the TELEVISION ANALYST and the television receiver for the best test pattern display.
3. Adjust the ion trap or centering adjustment of the television receiver so the center circle of the test pattern coincides with the physical center of the screen.

   NOTE

   If the test pattern is badly distorted, perform the linearity adjustments (or troubleshoot and repair if necessary) before the centering adjustment is finalized.
4. If the television receiver has a width adjustment, adjust it so the raster just fills the screen.
5. Adjust the height adjustment so the outer circle of the test pattern just fills the screen vertically.
6. Adjust the vertical linearity and horizontal linearity adjustments for a round outer circle and round inner circles on the test pattern display.
7. Wipe the grease pencil centering marks from the face of the picture tube.

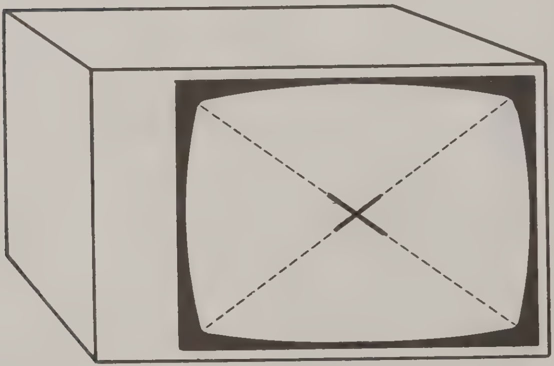


Figure 54. Marking Physical Center of Screen

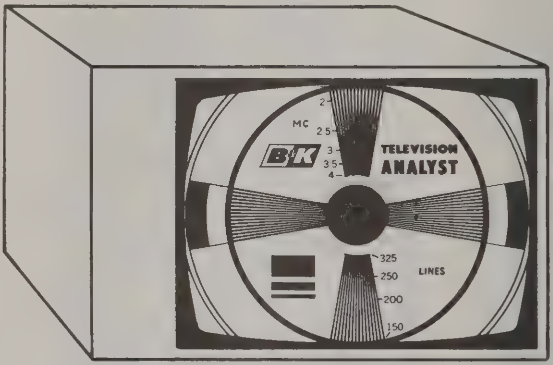


Figure 55. Proper Centering, Size, and Linearity

B. COLOR DEMODULATOR ALIGNMENT

(See Figures 56-57)

1. Inject vhf signal at the antenna terminals of the television receiver. Insert the test pattern slide in the TELEVISION ANALYST and adjust the controls on the TELEVISION ANALYST and the television receiver for the best black and white test pattern display.
2. Remove the test pattern slide and turn the COLOR control to 2. Adjust the controls on the television receiver for best color reception, and correct colors on the color bars, insofar as possible.
3. Connect an oscilloscope of adequate bandwidth to the output of the R-Y amplifier. Set the oscilloscope sweep frequency to 15,750 Hz. A waveform similar to that shown in Figure 56 will be displayed on the oscilloscope.
4. Set the hue control to the center of its range, then adjust the coarse hue control adjustment for zero amplitude on the 6th bar of the oscilloscope display.
5. Move the oscilloscope connection to the output of the B-Y amplifier. Adjust the quadrature transformer which drives the B-Y demodulator so that the 3rd bar is at zero amplitude as shown in Figure 57.

The 6th bar is the blue color bar which is adjusted for zero amplitude in the red demodulator, and the 3rd bar is the red color bar which is adjusted for zero amplitude in the blue demodulator. None of the blue signal gets through the red amplifier and none of the red signal gets through the blue amplifier. The G-Y amplifier is normally driven by the output of the red and blue demodulators, thus no red or blue signals get through the green amplifier.

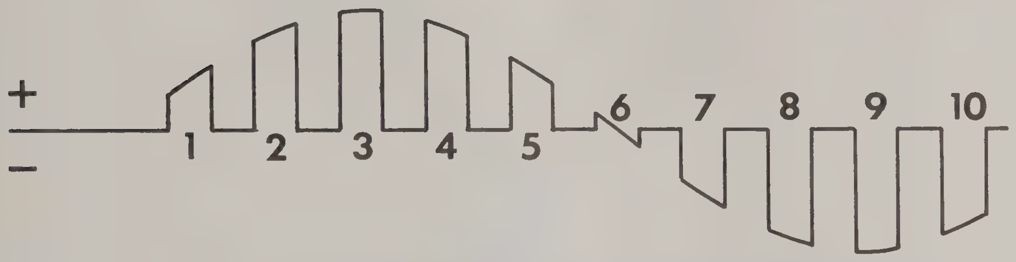


Figure 56. R-Y Amplifier Output as Seen on an Oscilloscope

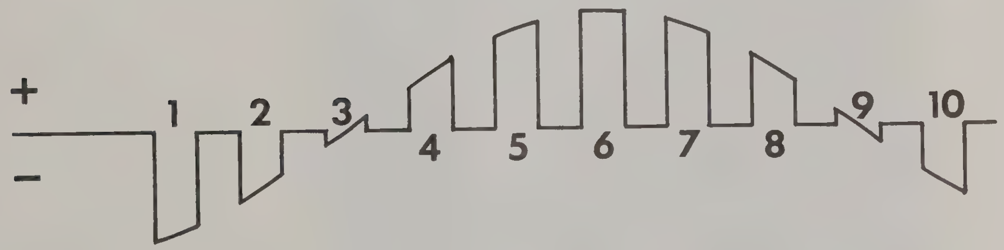


Figure 57. B-Y Amplifier Output as Seen on an Oscilloscope

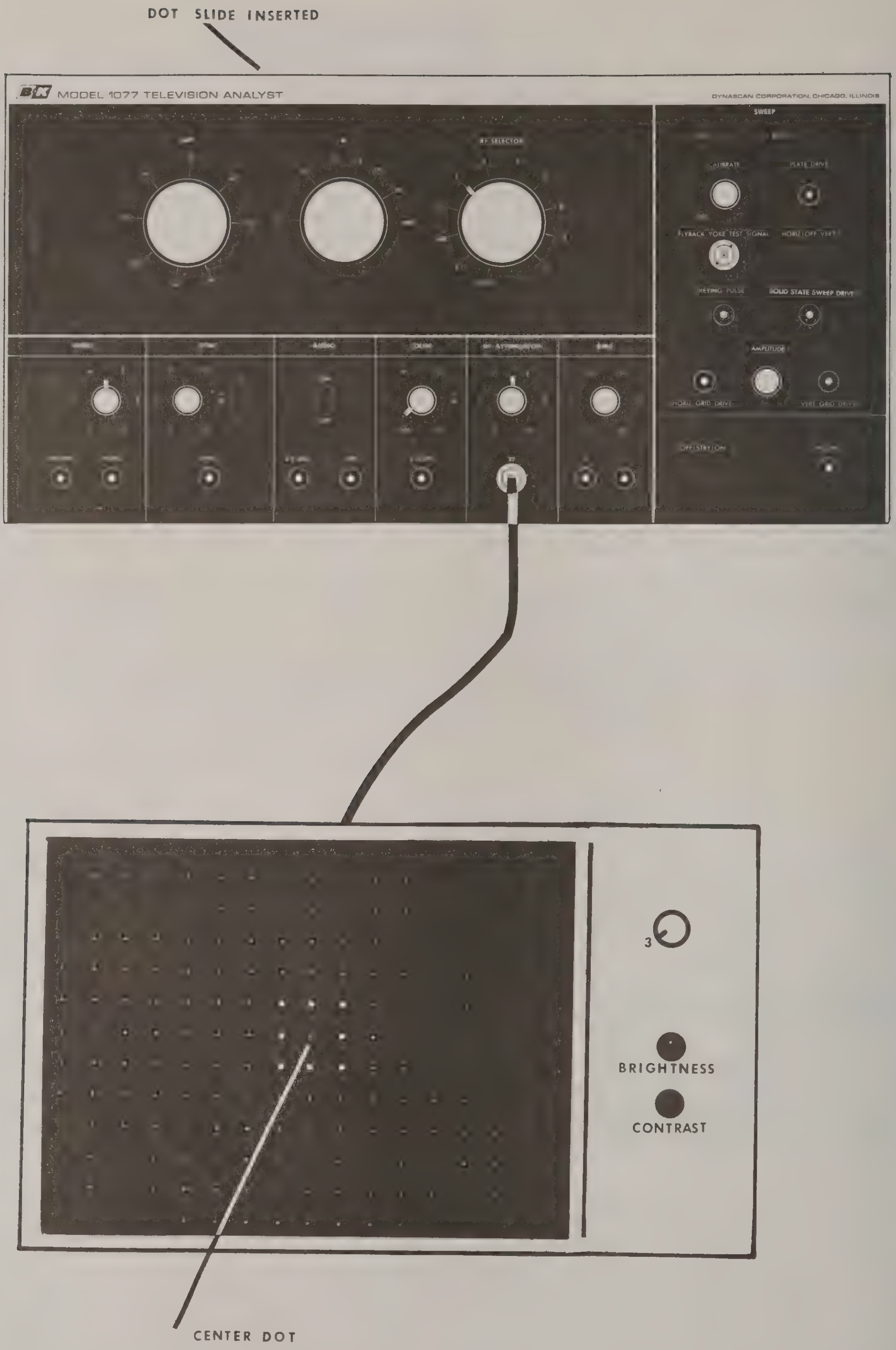


Figure 58. Insert Dot Pattern Slide for Static Convergence Adjustment

C. COLOR CONVERGENCE

(See Figures 58-59-60)

This portion of the manual provides general color convergence instructions and tells how to use the TELEVISION ANALYST as the signal source for color convergence. For complete color convergence instructions for a specific television receiver, refer to the manufacturer's instructions. These will vary from model to model.

1. Set the high voltage for the value specified by the manufacturer (typically 23.5 kv).
2. Adjust the centering, size, and linearity for black and white reception. Refer to the instructions in paragraph A of this section.
3. Degauss the cabinet and the face of the picture tube with a degaussing coil. This step should be performed even if the television receiver has a built-in degaussing coil. They are usually insufficient to correct for large amounts of magnetism.
4. For static convergence adjustments, insert the dot slide into the TELEVISION ANALYST and adjust the static convergence magnets for a white center dot. The center dot is easily identified because it is surrounded by square dots. (See Figure 58)

   Adjust the brightness and contrast controls on the television receiver for a low brightness level that will keep the dot from blooming and becoming enlarged. It may be necessary to slightly increase the VIDEO amplitude; too much video will also cause the spot to bloom. A low brightness level will also make any misconvergence easier to see.

   Figure 59 shows the direction of motion of the red, blue, and green dots that movement of the static convergence magnets will produce. When the three dots are superimposed equally on the center dot, a white dot will result.

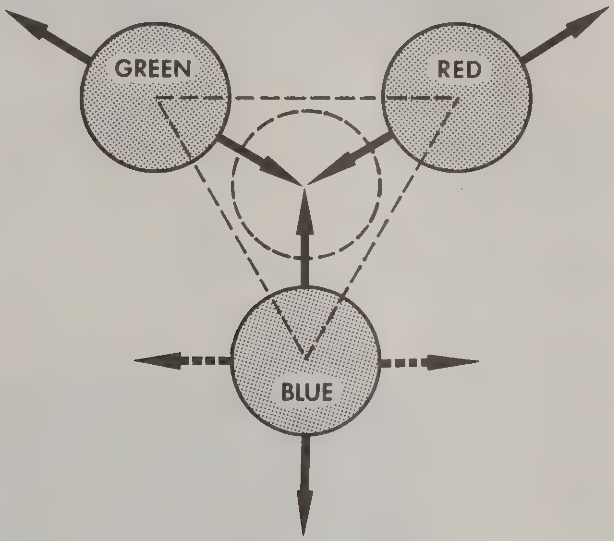


Figure 59. Direction of Dot Movement for Static Convergence

5. Color purity adjustments are made with a synchronized blank raster. The TELEVISION ANALYST provides such a signal by removing the slide. Do not merely reduce the VIDEO control setting to minimum; remove the slide entirely and leave the VIDEO control setting at a normal level. Refer to the manufacturer's instructions for color purity adjustment procedure.
6. It may be necessary to repeat the static convergence and color purity adjustments until there is no interaction.
7. Dynamic convergence is performed with the line slide inserted into the TELEVISION ANALYST. The center of the pattern is easily distinguished by dots which surround the center line intersection. (See Figure 60)

   Refer to the manufacturer's instructions for dynamic convergence adjustments. Adjust the brightness and contrast controls on the television receiver and the VIDEO control on the TELEVISION ANALYST so that the lines do not bloom and become enlarged. A brightness level at which the background becomes solid black, and fine white lines are visible is preferred. Any misconvergence is easiest to see at this brightness level.

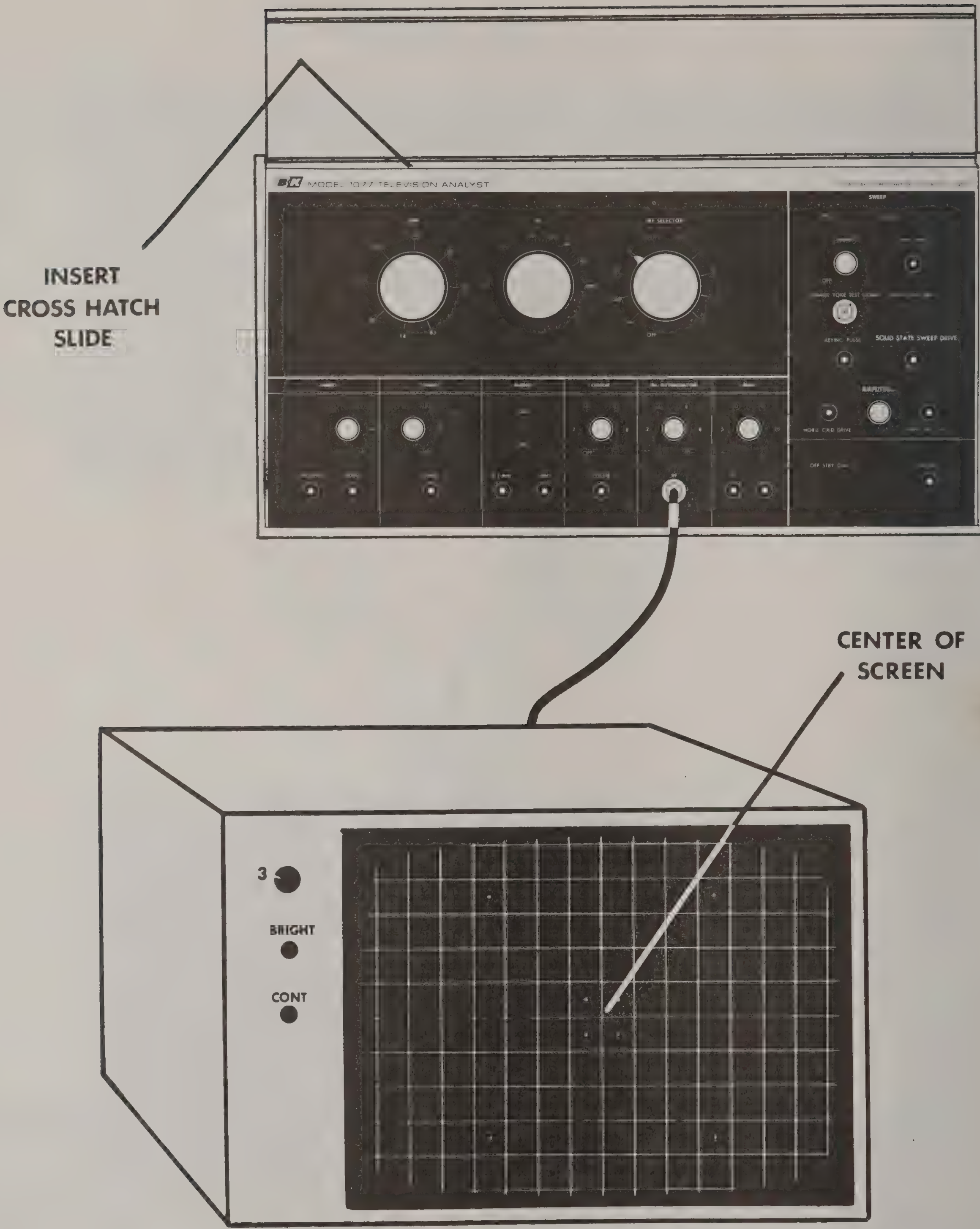


Figure 60. Insert Line Slide for Dynamic Convergence

PERFORMANCE TESTING

The TELEVISION ANALYST can be used to test overall performance of television receivers, including rf sensitivity, agc action, centering, size and linearity, shading, resolution and bandwidth, and frequency response. A performance test should be made at the conclusion of troubleshooting and repair of a trouble that disabled the television receiver. The performance test assures that all troubles are corrected and all adjustments have been made to restore peak performance. If the television receiver is returned to the customer in this condition, there will be few "call backs" and high customer satisfaction. Conduct all of the performance tests listed and take corrective action as required.

For all performance tests, insert the test pattern slide into the TELEVISION ANALYST and inject vhf or uhf signal at the antenna terminals of the television receiver. Tune the television receiver to bring in the test pattern and adjust for the best video.

A. RF SENSITIVITY TEST

Adjust the RF ATTENUATOR control to the lowest amplitude that will provide a picture suitable for viewing. Good rf sensitivity is always important, but especially so in fringe areas. Experience will soon show the highest setting of the RF ATTENUATOR control that will provide suitable viewing in your locality. For example, assume that the minimum acceptable rf sensitivity in your locality is a setting of 3 on the RF ATTENUATOR control. If you are testing a television receiver which has poor video at a control setting of 4 or 5 (or any setting higher than 3), the rf sensitivity of that set is low and steps should be taken to improve the gain. Stage gain checks of the rf and i-f amplifiers should be made to locate the low gain stage. Procedures for measuring gain with the TELEVISION ANALYST are given in both the *Typical Operating Procedure* and *Troubleshooting Procedures* sections of this manual. Realignment of the i-f section may also improve gain.

B. AGC ACTION TEST

Gradually increase the setting of the RF ATTENUATOR control from the low setting used in the rf sensitivity test to maximum. If the agc circuits are operating properly, the television receiver should be able to provide a good quality picture throughout this signal amplitude range. If agc action is inadequate, the picture will tear and produce the "overloaded video" symptom. Refer to that symptom in the *Troubleshooting Procedures* section of the manual for corrective action, but first attempt to correct inadequate agc action by adjusting the agc control on the television receiver.

C. SIZE, CENTERING, AND LINEARITY TEST

Refer to Figure 6 near the front of the manual for a view of the desired test pattern display. The outer circle of the test pattern should just fill the television screen vertically. The raster should fill the entire width of the screen and the outer circle and inner circles of the test pattern should be perfectly round. The outer circle should not reach the sides of the screen because the picture has greater width than height.

If these circles are not round, pictures will be distorted and out of proportion. The customer would notice this most on round objects.

If the television receiver fails this test, perform the applicable procedures from the "Adjustments" section of this manual. If adjustment will not correct the situation, troubleshoot the vertical or horizontal sweep circuits, as applicable.

D. SHADING CHECK

Again refer to Figure 6. Each of the circles at the center of the test pattern is a different shade of gray. Does the television receiver display these circles as separate, distinguishable shades of gray? Improper shading is the result of nonlinear amplification in the video section. Signal injection with the TELEVISION ANALYST may help you locate the specific stage which is causing the trouble.

E. RESOLUTION AND BANDWIDTH CHECK

With the controls on the TELEVISION ANALYST and the television receiver adjusted for the best video display, read the resolution and bandwidth directly from the test pattern that is displayed. Refer to Figure 6; the point at which the vertical lines merge and become indistinguishable is the point where the reading is taken. The bottom scale is marked to show resolution in number of lines, which is dependent upon bandwidth. Bandwidth is marked on the upper scale. Resolution should be at least 250 lines (bandwidth should be at least 3 MHz approximately) for good quality video. A narrower bandwith, and subsequently less resolution, will produce fuzzy images. The highest possible resolution is desired for sharp crisp images.

Poor resolution is usually caused in the video i-f section. Injection of i-f signal at various points may disclose an appreciable decrease in resolution at a specific point in the circuit. If so, that part of the circuit should be checked for a defective part or improper tuning. If no specific part of the i-f circuit can be defined as the cause of poor resolution, realignment of the rf and i-f sections should be performed.

F. FREQUENCY RESPONSE CHECK

The high frequency response was already checked with the resolution and bandwidth test in the previous step. However, if overcompensation is made for high frequencies, the vertical lines of the test pattern may be followed by multiple lines similar to ghost images. Furthermore, it should be possible to tune out the multiple lines with the fine tuning control.

Slight overcompensation can be detected by examining the black horizontal bars at the bottom of the image. The left hand edge will be excessively black and the right hand edge will be followed by a short, excessively white margin.

Low frequency response will also be checked by examining the black horizontal bars at the bottom of the image. Poor low frequency response allows the edges of the bars to be sharply defined, but they will change from black to an excessive white with a streamer shading from this white back to the normal background. The visual effect is one of smearing, with the smear going from left to right.

Poor frequency response, low or high, will probably require realignment of the i-f section.

OTHER USES FOR THE TELEVISION ANALYST

A. DISPLAY YOUR OWN PICTURES OR PATTERNS ON ANY TELEVISION RECEIVER

The TELEVISION ANALYST will transmit any picture or pattern that is in the form of a black and white positive transparency. The only restriction is that the size of the image area be 3 x 4 inches and the full size of the transparency be 4⅞ x 6½ inches to fit into the slide holder. Thus, any pattern may be drawn on a piece of clear plastic or acetate and displayed on any television receiver. To display photographs, have a positive film transparency made and use it in the slide holder.

B. DISPLAY ADVERTISING ON A GROUP OF TELEVISION RECEIVERS

The TELEVISION ANALYST has sufficient output to drive 10 or 12 television receivers simultaneously. More sets can be driven by using an antenna amplifier and feeding the output of the TELEVISION ANALYST into that unit. The advertising, or any other video presentation that is desired, can be made up on a positive transparency slide as described above. Then, for example, all the television receivers in a retail store could display the message. (See Figure 61)

C. SERVICING CABLE TELEVISION AND MASTER ANTENNA SYSTEMS

The TELEVISION ANALYST, since it generates test signals on all vhf and uhf channels, can be used to test and troubleshoot cable television and master antenna systems. These systems are primarily rf amplifier and converter items. The signal substitution method of troubleshooting is used, starting at the television receivers where the complaint of poor reception originated and working toward the master antenna.

D. VIDEO PAGING TRANSMITTER

The TELEVISION ANALYST can be used as a video paging transmitter at hospitals, conventions, and other gatherings. The information to be transmitted is written on a piece of clear acetate with crayon, grease pencil, or similar marker that may be easily wiped clean and reused, or it may be typewritten if desired. For typewritten messages, place the carbon side of two pieces of good quality carbon paper against the front and back side of the clear acetate and insert into the typewriter. Type the desired message and remove the carbons. Using the acetate slide in the TELEVISION ANALYST, the message will be clearly visible on the television monitor, and the acetate may be easily wiped clean and used again. Conventional audio paging may be used to direct the paged person to the television monitor for the visual message.

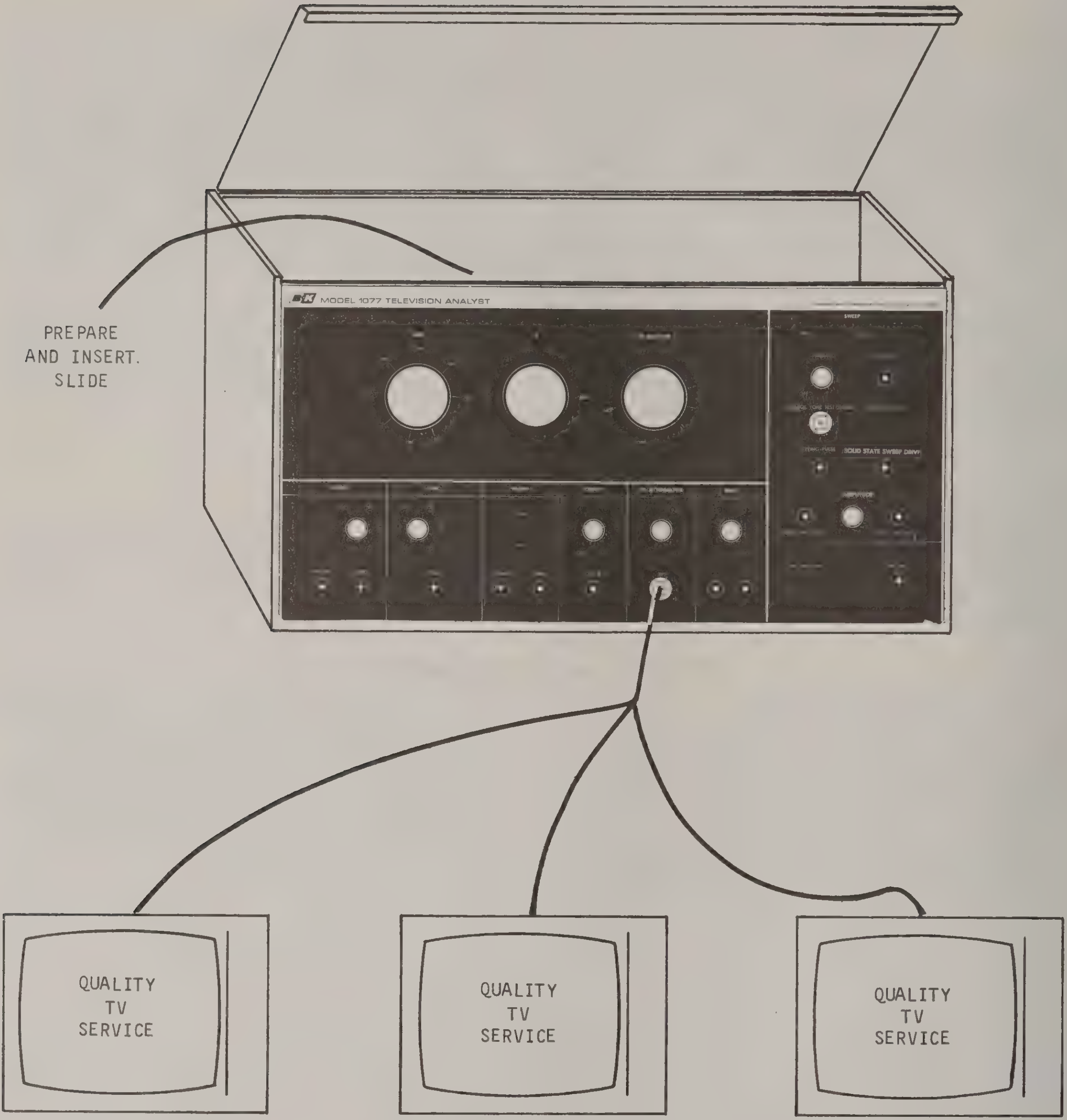


Figure 61. Using the TELEVISION ANALYST for Advertising Display

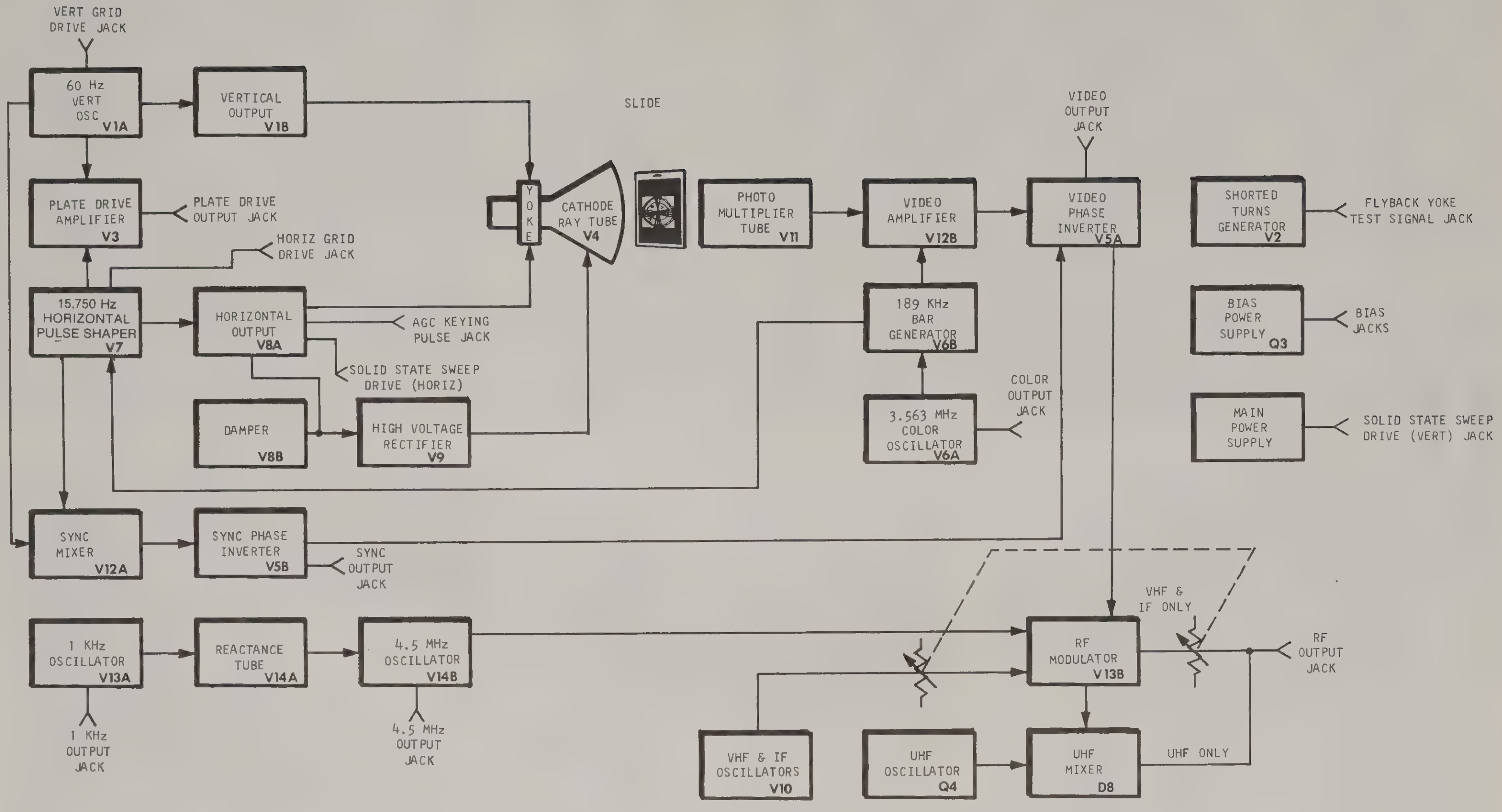


Figure 62. Block Diagram of the TELEVISION ANALYST

THEORY OF OPERATION

A. GENERAL

Refer to the block diagram (Figure 62) and the following explanations for functional operation of the TELEVISION ANALYST. Many of the stages in the TELEVISION ANALYST are basically the same as those used in many television receivers. Brief circuit descriptions are provided for these stages. Special circuits are described in greater detail.

B. SCANNING SECTION

(See Figures 63-64)

The scanning section is the heart of the TELEVISION ANALYST. It consists primarily of the cathode ray tube and the photo-multiplier tube. Basically, the following actions are performed in the scanning section:

- a dot of light scans the cathode ray tube
- a slide masks the light which reaches the photomultiplier tube
- the photomultiplier tube converts the light into a video signal that is equivalent to the image on the slide

An electron beam scans the face of the cathode ray tube just as in a television receiver. That is, the beam starts at the top and moves from left to right, retraces quickly to the left and moves down one line, then again moves from left to right. This is repeated until the beam reaches the bottom, then the whole process is repeated.

As the electron beam scans, it produces a flying dot of light. The light is directed toward a photomultiplier tube which produces an output signal that is proportional to the amount of light which strikes it. A positive transparency slide may be inserted between the cathode ray tube and the photomultiplier tube. As the small spot of light sweeps across the slide from left to right, light passes through the transparent portions of the slide and maximum output voltage is produced by the photomultiplier tube (see Figures 63 and 64). When the spot passes behind the black parts of the slide, no light reaches the photomultiplier tube and no output voltage is produced. Shades of gray in the transparency (partially transparent) will produce some output voltage, but less than the fully transparent areas. Thus, as the entire slide is scanned, the photomultiplier tube will produce a video signal equivalent to the image on the slide. If this same video signal is amplified and applied to the Video section of a television receiver, the image on the slide will be reproduced on the screen of that television receiver.

A special type of cathode ray tube is used in the TELEVISION ANALYST, and it is matched to the spectral response of the photomultiplier tube.

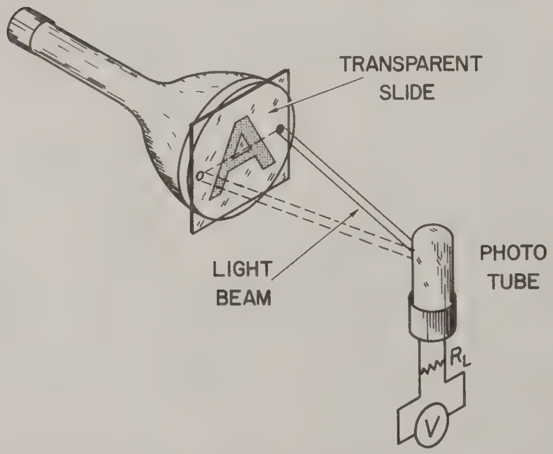


Figure 63. Changing a Visual Image to an Electrical Signal

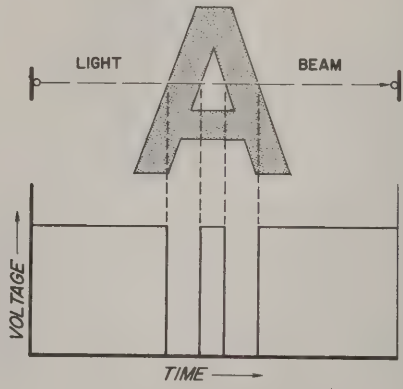


Figure 64. Voltage as Light Beam Moves Across Pattern

C. VERTICAL DEFLECTION SECTION

Vertical deflection of the "flying dot" is provided by this section of the TELEVISION ANALYST. It consists of the vertical oscillator and vertical output stages. The oscillator uses 60 Hz ac input power for synchronization. The ac power is applied across a transistorized clipping circuit and converts it into a square wave. Shaping and timing circuits further modify the signal into a sawtooth sweep signal. The VERT GRID DRIVE jack permits a signal to be taken directly from the stage for injection into a malfunctioning television receiver. Vertical size and linearity adjustments are included in the circuit. The vertical signal is also applied to the plate drive amplifier, which provides high level vertical test signals.

D. HORIZONTAL DEFLECTION SECTION

This section of the TELEVISION ANALYST provides horizontal deflection for the "flying dot". Signal from the 189 KHz color bar generator drives two CMOS IC dual D flip flops connected for a divide by twelve function to provide a crystal controlled horizontal frequency of 15,750 Hz. The output of the divider is applied to a two stage triode pulse shaping network which produces a sawtooth waveform available at the HORIZ GRID DRIVE jack for injection into television receivers.

In previous models of the TELEVISION ANALYST and all models built for the PAL color system, horizontal deflection is produced by a multivibrator synchronized by a sub-multiple of the color bar generator. In these models, an internal frequency adjustment, R-54, is provided.

The output of the horizontal pulse shaper is continuously applied to the horizontal output stage. The horizontal output stage contains an amplifier and conventional flyback transformer. These devices drive the yoke to give horizontal deflection. A width coil shunts the yoke a variable amount to adjust horizontal size. The flyback transformer, in conjunction with the damper and high voltage rectifier, provide approximately 12.5 kv high voltage for the cathode ray tube. Boosted B+ is developed by the flyback transformer and damper for use as plate voltage by many of the stages in the TELEVISION ANALYST. The KEYING PULSE is taken directly from a winding of the flyback transformer.

The horizontal signal is applied to the plate drive amplifier. A switch allows the operator to select vertical or horizontal sweep signal as the input to the plate drive amplifier. The switch also has an OFF position which disables the amplifier. The output signal, used for signal injection trouble-shooting, is taken at the PLATE DRIVE jack.

E. SYNC SECTION

Output from the vertical oscillator and horizontal oscillator are sampled and applied to a sync mixer. The sync mixer provides isolation between the two inputs, but produces an amplified sync signal containing both vertical and horizontal sync pulses at its output.

This composite sync signal is applied to the sync phase inverter stage which provides output at both the cathode and plate. The SYNC POLARITY switch selects the cathode signal in the positive position and plate signal in the negative position. The output signal is available from the SYNC jack for injection into television receivers. The amplitude of the signal at the jack is adjusted by the SYNC control, but this control has no effect upon the amplitude of the signal within the TELEVISION ANALYST. An internal adjustment sets this level.

F. VIDEO SECTION

The video signal is produced by the photomultiplier tube. The amplitude of this signal is adjusted by the VIDEO control. Additional amplification is provided by the video amplifier stage. It is here that color signal is added whenever color is used (see paragraph G below. The output of the video amplifier is applied to the video phase inverter along with the composite sync signal. A composite video signal with vertical and horizontal sync pulses is provided at both the plate and cathode of this stage. Since these signals are of opposite polarities, the video polarity switch selects a positive signal by connecting the plate output to the VIDEO jack or a negative signal by connecting the cathode output to the VIDEO jack.

G. COLOR SECTION

The color signal is provided by a 3.563 MHz crystal controlled oscillator. This signal, when demodulated against a 3.58 MHz oscillator signal in the television receiver, produces a full 360° phase difference in the time required for one horizontal scan. Since the phase difference is converted to color, and the phase linearity shifts from 0° through 360° as it moves from left to right on each horizontal scan, a full rainbow of colors is generated. The rainbow color signal is available at the COLOR jack and is adjustable by the COLOR control. The control does not affect the amplitude of the color signal used internally in the TELEVISION ANALYST. The OFF position disconnects the oscillator from the output points.

The 189 KHz bar generator is essentially a crystal controlled oscillator with wave shaping components to produce a 189 KHz square wave. A low level 3.563 MHz color rainbow signal is also injected into the stage, with the resultant output a gated color signal which produces the bars of color when displayed on a television screen. The rainbow signal is blocked by the negative portion of the square wave, but the color rainbow signal passes during the positive portion of the square wave. This gated color signal is fed to the video amplifier stage where color signal is added to the black and white video signal which may be present there. The 189 KHz square wave is also coupled to the horizontal oscillator to keep the color bars in sync with the horizontal sweep.

H. SOUND SECTION

The 1 KHz oscillator operates continuously when the TELEVISION ANALYST is turned on. It produces a tone output which is available at the 1 KHz jack. The tone is also applied to a reactance tube which frequency modulates the 4.5 MHz oscillator at a 1 KHz rate. Approximately 25 KHz of deviation is produced. The 4.5 MHz oscillator is turned on and off by the AUDIO switch. Its output is available at the 4.5 MHz jack. The output is also applied to the rf modulator stage which is described in the next paragraph.

I. RF SECTION

The vhf oscillator operates similar to most television tuners with a different coil selected for each channel selection. These coils are pre-tuned to the correct frequency. The same oscillator is used for i-f signal generation, but a front panel tuning control gives a 20 to 48 MHz frequency range. The oscillator output is routed to the rf modulator. The RF ATTENUATOR control adjusts the amplitude of the signal. The rf modulator mixes the rf signal with the video signal (including color which was pre-mixed) and the audio signal. The output of the rf modulator is an rf signal modulated with sync pulses, video, color, and sound. The other part of the RF ATTENUATOR control adjusts the output level at the RF jack.

When the CHANNEL SELECTOR is in the UHF position, the rf oscillator operates, producing a modulated rf signal from the rf modulator stage into the uhf mixer. The uhf oscillator is also energized at this time. It also feeds the uhf mixer. The resultant output of the uhf mixer is a modulated uhf signal at the RF jack.

J. SHORTED TURNS GENERATOR

The FLYBACK YOKE TEST SIGNAL jack provides the signal for testing flyback transformers and horizontal yoke windings for shorted turns. The stage which drives this jack is a high "Q" oscillator. Shorted turns reduce the "Q" of the oscillator circuit, which causes the bias to shift on an associated bulb driver stage. The bias shift causes the stage to conduct and lights the TEST INDICATOR lamp. As little as one shorted turn will reduce the "Q" sufficiently to light the test lamp.

K. POWER SUPPLIES

The bias power supply is a floating power supply; that is, it has no connection to the chassis of the TELEVISION ANALYST. It provides a dc voltage output of either polarity, depending upon the polarity of the connections. It provides up to ¼ ampere of current. The output voltage is somewhat dependent upon the current, but is adjusable from 0 to 25 volts into a high impedance circuit. The source impedance of the power supply is very low.

The power supply for the TELEVISION ANALYST is a conventional transformer type. A full wave rectifier provides 200 volts B+ as plate voltage for many of the stages. Silicon diodes also develop a negative voltage for application to the cathode of the photomultiplier tube and the phase inverter stages. When the OFF-STBY-ON switch is in the STBY position, voltage is applied only to the filaments of the tubes and bias jacks. This way, oscillators can be stabilized and immediate operation is available by merely setting the switch to ON.

ADJUSTING THE TELEVISION ANALYST FOR LOCAL CONDITIONS

The TELEVISION ANALYST is ready for operation as shipped from the factory, but a few adjustments may peak the instrument for most satisfactory operation in your locality. This is primarily due to the fact that all television stations do not produce an identical test pattern. The TELEVISION ANALYST should be adjusted to produce the same linearity, etc. as the local station. These adjustments should be checked periodically and readjusted if necessary.

1. All areas have available at some time during the week a standard test pattern from a local television station. Find out when this pattern is available and warm up a television receiver in good operating condition and the TELEVISION ANALYST for 5 minutes before starting.

2. Tune the television to the local station which is transmitting the test pattern. Follow the Centering, Size, and Linearity adjustment instruction from the Adjustments section of this manual using this signal. Mark the exact center and the circles of the station test pattern on the face of the screen with crayon or similar marker.

3. Tune to an unused channel and inject the test pattern signal from the TELEVISION ANALYST. Readjust the fine tuning if necessary for best resolution. DO NOT READJUST CONTROLS ON THE TELEVISION RECEIVER, IT IS SERVING AS THE CALIBRATION STANDARD FOR THE TELEVISION ANALYST.

4. Adjust the centering, vertical size and linearity, horizontal size, and width controls on the TELEVISION ANALYST so that the test pattern is superimposed over the circles that have been drawn on the face of the screen.

5. The CHANNEL SELECTOR provides vhf signals on channels 2, 3, 4, 6, 7, 8, 12, and 13. These channels should ordinarily provide all the channels necessary for testing. If, however, you desire a test signal on channel 5, 9, 10, or 11, these can be obtained by readjusting the coils of an adjacent channel. The following table provides readjustment instructions:

DESIRED CHANNEL	READJUST COIL OF CHANNEL	TURN COIL SLUG
5	6	4 turns counterclockwise
9	8	1½ turns clockwise
10	8	2½ turns clockwise
11	8	4 turns clockwise

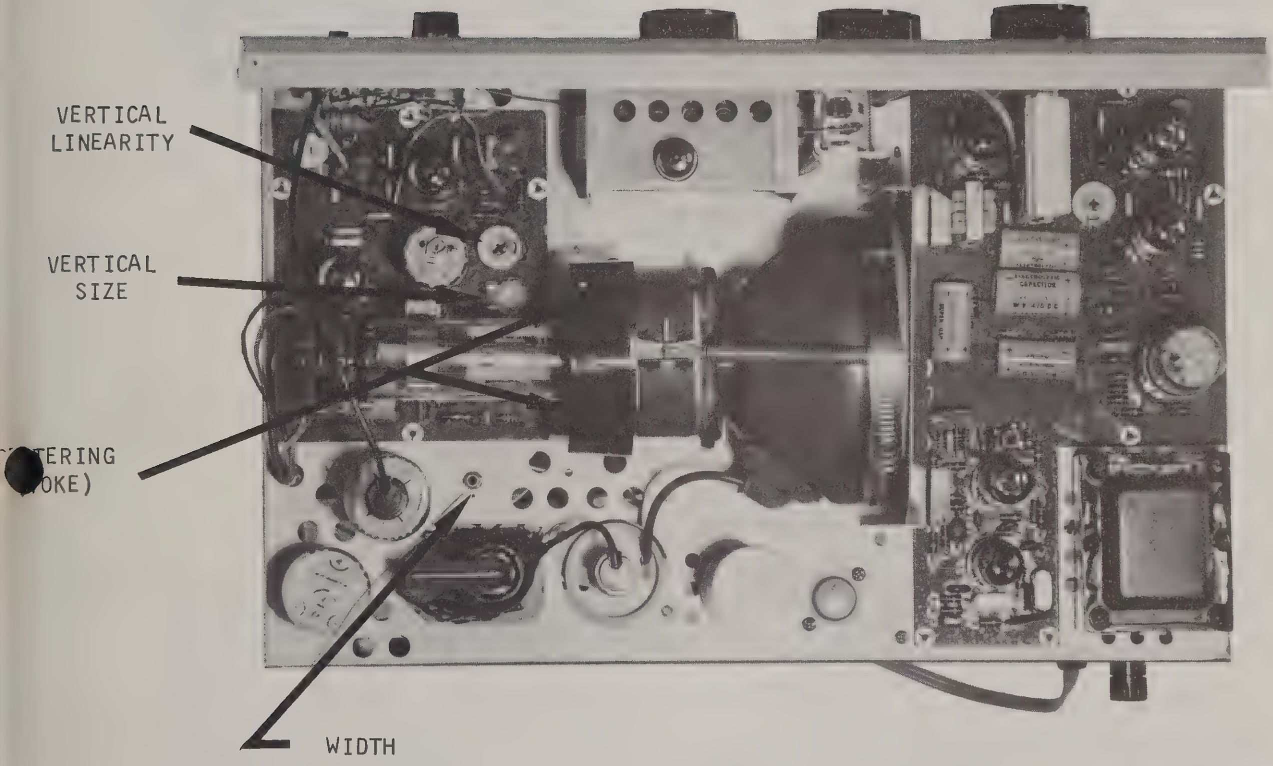


Figure 65. Size and Linearity Adjustment Locations

MAINTENANCE

A. GENERAL

Very little periodic maintenance is required. A periodic check of the adjustments listed in the *Adjusting the TELEVISION ANALYST for Local Conditions* section of the manual and occasional cleaning of the face of the cathode ray tube are the only recommended steps. Any time that the instrument does not meet the specifications listed at the beginning of the manual, adjustment or repair should be performed. Calibration of the instrument must be maintained if the television receivers which you service are to be tuned to peak performance.

In the event of instrument failure, presence or absence of the output signals at the various jacks will isolate the trouble to one or two stages (see the block diagram Figure 62). Tubes from the suspected stages should be tested or substituted. If tube replacement does not restore operation, voltage checks at a few points in the circuit should reveal the trouble.

Figure 66 illustrates removal of the housing of the TELEVISION ANALYST for access to the circuits. Figure 67 shows the tube and fuse locations. The following table will help correlate tube locations in Figure 67 with the stage names on the block diagram (Figure 62).

TUBE REFERENCE DESIGNATION	STAGE NAME
V1	Vertical Oscillator and Amplifier
V2	Shorted Turns Generator
V3	Plate Driver
V4	Cathode Ray Tube
V5A	Video Paraphase Amplifier
V5B	Sync Paraphase Inverter
V6	Color Oscillator and 189 KHz Oscillator
V7	Horizontal Pulse Shaper
V8	Horizontal Output and Damper
V9	High Voltage Rectifier
V10	VHF-IF Oscillator
V11	Photomultiplier
V12A	Sync Mixer
V12B	Video Amplifier
V13A	1 KHz Oscillator
V13B	RF Modulator
V14	4.5 MHz Oscillator and Reactance Modulator

B. SERVICE ADJUSTMENTS

Linearity and size adjustments are described in the *Adjusting the TELEVISION ANALYST for Local Conditions* section of this manual.

SYNC LEVEL—Measure the signal amplitude at the grid of the rf modulator on an oscilloscope and adjust for 0.7 volt peak-to-peak sync signal.

4.5 MHz OSC—Adjust to exactly 4.5 MHz. If an accurate 4.5 MHz standard oscillator is available, feed both signals into a mixer and adjust the 4.5 MHz control for a zero beat. If no accurate standard is available, tune a television receiver to a local channel and adjust the discriminator for an absolute zero output. Now inject the 4.5 MHz signal into the same discriminator and adjust the 4.5 MHz for absolute zero output from the discriminator.

BEAM CURRENT—Adjust the cathode current of the cathode ray tube for 75 microamperes.

RF-IF OSCILLATOR COILS—These coils are factory adjusted and should not normally have to be readjusted. If adjustment is required, an accurate signal source must be used and the two signals zero beat. This adjustment can be approximated by tuning the television receiver to a local station and simultaneously injecting a signal from the TELEVISION ANALYST on the same channel. Turn the VIDEO control to zero. The zero beat can be seen on the screen.

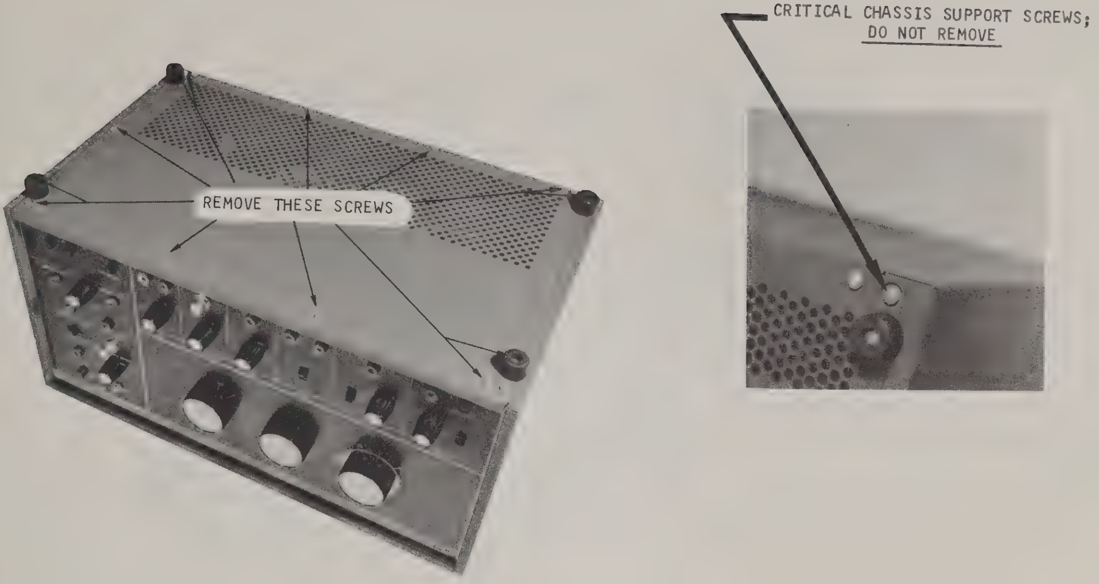


Figure 66. Removal of Housing

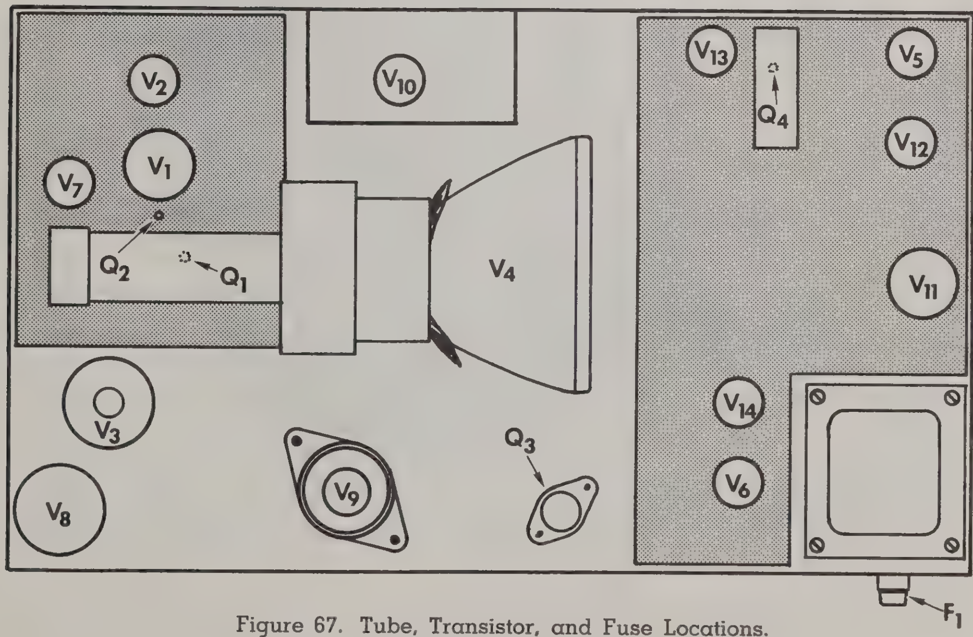


Figure 67. Tube, Transistor, and Fuse Locations.

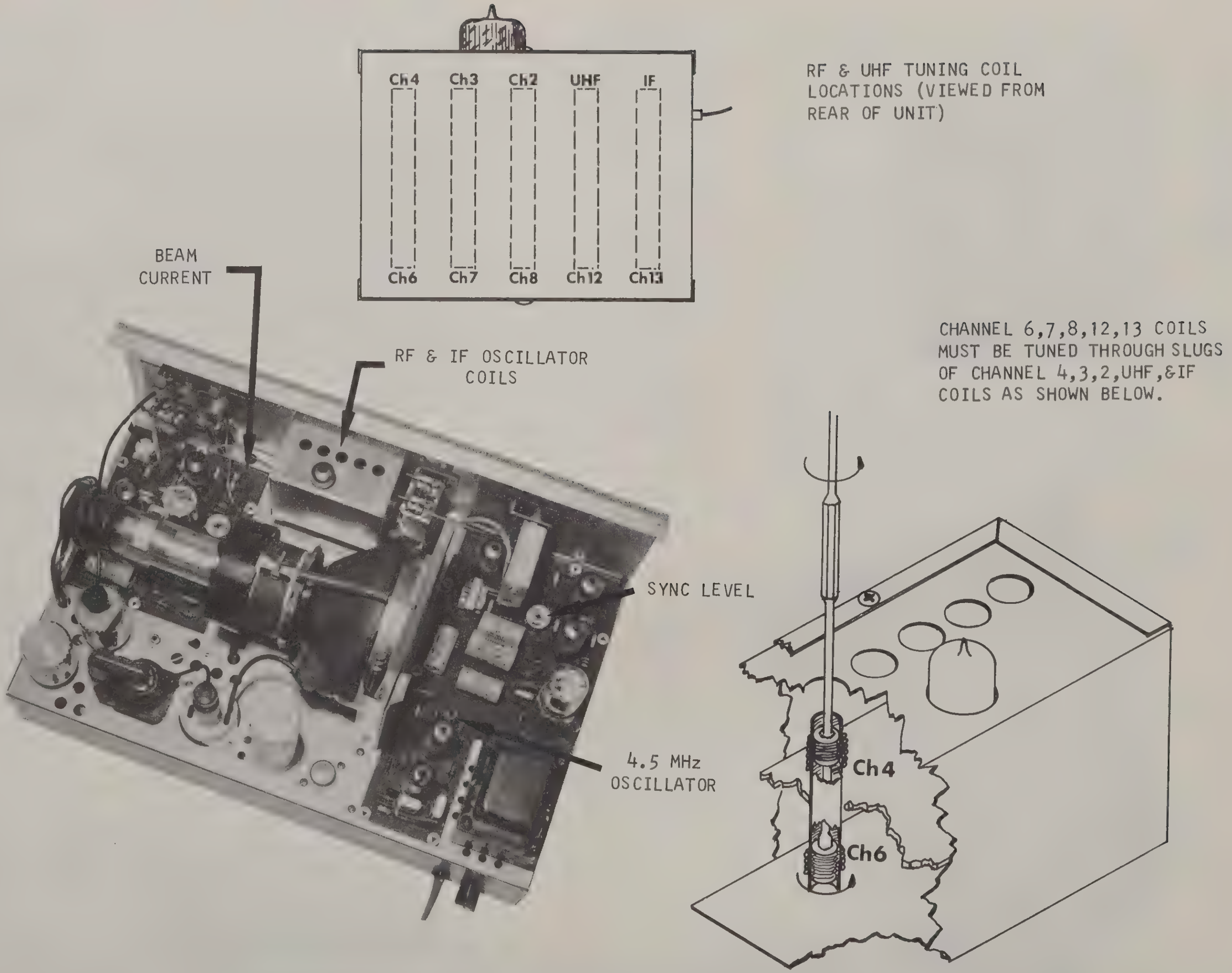

Ch4
Ch3
Ch2
UHF
IF
Ch6
Ch7
Ch8
Ch12
Ch13
RF & UHF TUNING COIL LOCATIONS (VIEWED FROM REAR OF UNIT)
BEAM CURRENT
RF & IF OSCILLATOR COILS
CHANNEL 6,7,8,12,13 COILS MUST BE TUNED THROUGH SLUGS OF CHANNEL 4,3,2,UHF,&IF COILS AS SHOWN BELOW.
SYNC LEVEL
4.5 MHz OSCILLATOR
Ch4
Ch6

Figure 68. Service Adjustment Locations

WARRANTY SERVICE INSTRUCTIONS

1. Refer to the maintenance section of the instruction manual for adjustments that may be applicable.
2. Defective parts removed from units which are within the warranty period should be sent to the factory prepaid with model and serial number of product from which removed and date of product purchase. These parts will be exchanged at no charge.
3. If the above-mentioned procedures do not correct the difficulty, pack the product securely (preferably in original carton or double-packed). A detailed list of troubles encountered must be enclosed as well as your name and address. Forward prepaid (express preferred) to the nearest B & K-Precision authorized service agency.

Contact your local B & K-Precision Distributor for the name and location of your nearest service agency, or write to

Service Department

B & K-Precision Product Group
DYNASCAN CORPORATION
2815 West Irving Park Road
Chicago, Illinois 60618

ONE YEAR LIMITED WARRANTY

"DYNASCAN warrants that each product manufactured by it will be free from defects in material and workmanship under conditions of normal use and service for a period of one (1) year from the date of purchase from an authorized DYNASCAN distributor. DYNASCAN will, at its option, repair or replace any product or component not conforming with the foregoing warranty and which is returned, transportation prepaid, to our factory or our authorized service contractor. *DYNASCAN shall not otherwise be liable for any damages, consequential or otherwise.* DYNASCAN makes no other express warranties. *Any implied warranties (including any warranty of merchantability) are limited in duration to (1) one year from the date of purchase.* This warranty does not apply to (i) damage resulting from unauthorized alterations and repairs, misuse, negligency or accident; or (ii) damage resulting from improper installation, connection or adjustment otherwise than in accordance with DYNASCAN's authorized Instruction Manual. This warranty is void if the serial number has been altered, defaced or removed. DYNASCAN reserves the right to discontinue any model at any time or change specifications or design without notice and without incurring any obligation. To register this warranty, the enclosed DYNASCAN warranty registration card should be completed and mailed to DYNASCAN CORP., 1801 W. Belle Plaine Avenue, Chicago, Illinois 60613, within ten (10) days after date of purchase.

INSTRUCTION MANUAL

B&K Model E-200D

RF Signal Generator

B&K PRECISION SOLID STATE MODEL E-200D RF SIGNAL GENERATOR
PRODUCT OF DYNASCAN CORPORATION
ATTENUATOR
%MOD
MOD LEVEL
FINE ATTENUATOR
RANGE
XTAL CALIBRATOR
OFF
300 KHz
MODULATION
EXT MOD

A Product of DYNASCAN CORPORATION 1801 West Belle Plaine • Chicago, Illinois 60613

B&K

PRICE $2.00

Dear Friend:

Congratulations on your purchase of B & K — Precision Test Equipment, and welcome to the B & K family. We hope your experience with your new test equipment will make you a lifetime B & K customer.

Your instrument is backed by more than 20 years of experience in designing and manufacturing. Our most important goal is your satisfaction. At B & K, test equipment is made to meet the demands of the field, focusing on dependability and accuracy. We also concentrate on simplicity and operating ease with features that reduce the possibility of human error and speed the servicing process.

In order to determine the type of test units that are needed we have been guided by letters and reports from technicians and engineers who use the equipment daily. Our field tests and studies have helped provide better and faster service techniques. Close contact has been maintained with the manufacturers of consumer products which our test units will be checking and trouble-shooting.

Key personnel in our company cut their eye teeth in the TV service business. This is why we have more "sensitivity" for the problems and conditions under which the test equipment will be used.

B & K product designs are constantly reviewed, and refinements are made or new models developed to meet advances in our industry and to fill your needs. We set our standards high so you can be assured that the B & K test instruments you buy represent advanced design, quality construction, and dependable long-term performance at a price you can afford.

If you have any comments or thoughts about our products, or test equipment in general, I would be delighted to hear from you.

Thanks for your confidence in B & K and we look forward to serving you for a long time to come.

Sincerely,

Carl Korn

Carl Korn
President

INSTRUCTION MANUAL

FOR

B & K/PRECISION

MODEL E-200D

R F SIGNAL GENERATOR

B & K DIVISION OF DYNASCAN CORPORATION
1801 W. Belle Plaine Avenue
Chicago, Illinois 60613

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B&K/PRECISION MODEL E-200D
R F SIGNAL GENERATOR

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SPECIFICATIONS

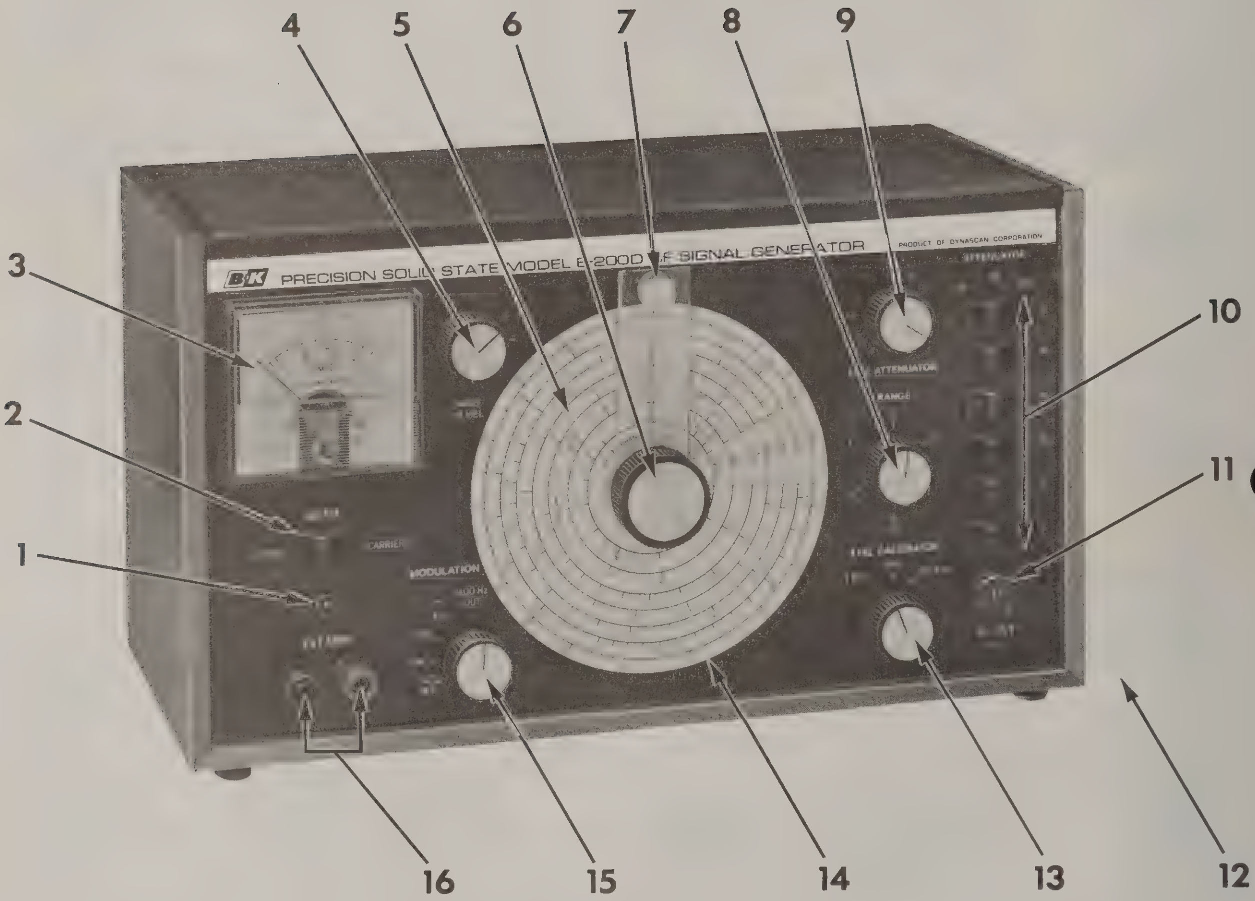
FREQUENCY RANGE	100 kHz to 54 MHz in five fundamental bands. 32 MHz to 216 MHz in two harmonic bands. BAND A 100 kHz to 370 kHz BAND B 370 kHz to 1400 kHz BAND C 1.4 MHz to 5.1 MHz BAND D 5.1 MHz to 16 MHz BAND E 16 MHz to 54 MHz BAND H_2 32 MHz to 108 MHz (harmonic) BAND H_4 64 MHz to 216 MHz (harmonic)
FREQUENCY ACCURACY	± 1.5% of highest frequency on any given band, usable to ± 0.1% with crystal calibrator.
MAXIMUM OUTPUT LEVEL	Output open circuited, meter uncalibrated: BAND A 3 V rms minimum BAND B 2 V rms minimum BAND C 0.6 V rms minimum BAND D 0.3 V rms minimum BAND E 0.3 V rms minimum BAND H_2 uncalibrated harmonic output BAND H_4 uncalibrated harmonic output
CALIBRATED OUTPUT	—106 dB (0.5 microvolt) to + 2 dB (126,000) microvolts) into 50-ohm load. Carrier meter covers —10 to + 2 dB range (reference 0 dB = 100,000 microvolts into 50-ohm load); attenuators extend range to —106 dB.
CALIBRATED OUTPUT ACCURACY	±1 dB 100 kHz to 54 MHz

ATTENUATORS	Six step attenuators of 20 dB, 20 dB, 20 dB, 20 dB, 10 dB and 6 dB (96 dB total) plus fully adjustable fine attenuator control.
MODULATION TYPE	CW or amplitude modulation
INTERNAL MODULATION	400 Hz ± 20% from bridged "T" two-stage oscillator; adjustable level.
EXTERNAL MODULATION SENSITIVITY	Approximately 1 V rms for 50% modulation at 400 Hz.
MODULATION METER	Reads 0 to 50% modulation for internal or external modulation; accuracy ± 5% from 100 kHz to 30 MHz.
CRYSTAL CALIBRATOR	Crystal calibration points every 1 MHz and 100 KHz (derived). Accuracy 0.05%. Built-in detector, amplifier and speaker for "zero beating".
400 Hz OUTPUT	Output of internal modulation oscillator available for external use at EXT MOD jacks. Level: 1.25 volts maximum Impedance: 5K ohms at maximum level. Distortion: Less than 0.5%
POWER REQUIREMENTS	117 VAC, 50/60 Hz, 6 watts
SIZE	12¾" wide x 7¼" high x 8" deep
SHIPPING WEIGHT	Approximately 14 pounds

FEATURES

WIDEST FREQUENCY RANGE	Continuous coverage from 100 kHz to 216 MHz in seven frequency bands (54 MHz to 216 MHz signals use harmonic output). No gaps in coverage. Covers AM broadcast band, FM broadcast band, amateur, short wave and two-way communications bands, and all VHF television channels, plus all i-f frequencies.
FULLY SOLID STATE	Uses 18 semiconductor devices for all the advantages of solid state technology; reliability, ruggedness, instant warm-up, low power consumption, no high voltage, light weight and compactness.
FULLY SHIELDED	Oscillators and attenuators are shielded to reduce "spray" radiation; a neccessity when testing and aligning high sensitivity receivers.
SINUSOIDAL OUTPUT	Sinusoidal rf output signal has very low distortion on fundamental output ranges to 54 MHz.
VERNIER SCALE TUNING	A 6.1 gear reduction ratio between the tuning knob and the dial allows the dial to be easily and accurately set.
EASY-TO-READ DIAL	A large circular two-color dial (15-inch circumference with seven separate frequency scales provides easy, accurate direct frequency readings. Key frequencies and frequency ranges are identified: Broadcast receiver i-f; FM i-f; TV i-f sound and video frequencies; FM band; VHF TV Video Carrier frequencies for all 12 VHF channels.

CALIBRATED OUTPUT LEVEL	A carrier level meter and step attenuators provide accurately calibrated output level measurement from —106 dB to +2 dB (0.5 uV to 126,000 uV) when using the 50-ohm terminated cable that is supplied with the instrument.
ADJUSTABLE MODULATION	A modulation percentage meter and modulation level adjustment permit calibrated modulation from 0 to 50%, with higher uncalibrated levels (up to 100%) possible.
FREQUENCY ACCURACY	A built-in crystal controlled oscillator, "zero beat" circuit and adjustable cursor marker provide dial accuracy of 0.1%.
INTERNAL MODULATION	Internal 400 Hz oscillator provides low distortion modulation voltage.
400 Hz OUTPUT	The output of the 400-Hz oscillator is available at the external modulation jacks for use as an audio test signal. Thus, the signal generator can be used for complete testing of both the rf and audio sections of a receiver. The level is fully adjustable from 0 to 1.25 volts rms.
PILOT LAMP EASE OF OPERATION	Lets you tell at a glance whether instrument is on or off. Controls and indicators are "operator designed". Related controls are grouped, lettering is easy to read and "explains" rather than confuses. Simplified control layout for calibration accuracy eliminates complicated conversion tables and graphs for precision frequency and output level settings.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B+K PRECISION SOLID STATE MODEL E-200D RF SIGNAL GENERATOR
PRODUCT OF DYNASCAN CORPORATION
ATTENUATOR
RANGE
CARRIER
MODULATION
400 Hz
OUT

Figure 1. Operator's Controls and Indicators

OPERATOR'S CONTROLS AND INDICATORS

(Refer to Figure 1)

1. Pilot lamp—Lights continuously when signal generator is turned on.

2. METER switch

   % MOD position—Connects meter to measure percentage of modulation.

   CARRIER position—Connects meter to measure carrier (rf output signal) level.

3. Meter—Indicates carrier level in dB on top (red) scale or percentage of modulation on bottom (black) scale. Use the scale which corresponds to the METER switch position.

   NOTE

   The rf output must be terminated in a 50-ohm lead when using the carrier scale for calibrated output level.

4. MOD LEVEL control—Adjusts percentage of modulation for internal or external modulation. Adjusts level of 400-Hz tone output when MODULATION switch is in 400 Hz OUT position.

5. Dial—Indicates the frequency of the output signal. Use the scale which corresponds to the RANGE switch position.

6. Frequency control—Adjusts the dial frequency.

7. Cursor marker adjustment—Adjusts the cursor marker for highly accurate frequency readings when used with the crystal calibrator.

8. RANGE switch—Selects the frequency range for the output signal as follows:

   Range A —100 kHz to 370 kHz

   Range B —370 kHz to 1400 kHz

   Range C —1.4 MHz to 5.1 MHz

   Range D —5.1 MHz to 16 MHz

   Range E —15 MHz to 54 MHz

   Range H_2—30 MHz to 108 MHz

   Range H_4—60 MHz to 216 MHz

9. FINE ATTENUATOR control—Fine setting of output level.

10. ATTENUATOR selectors—Coarse setting of output level. Six individual attenuators of 20, 20, 20, 20, 10 and 6 dB permit steps from 0 to 96 dB. Each switch has two positions as follows:

    IN position—adds attenuation

    OUT position—removes attenuation

11. RF OUT jack — Connector for output signal. Mates with microphone type connector.

12. RF output cable—Connects output signal to equipment being tested or aligned. Cable contains 50-ohm termination. Use an unterminated cable if the output is being fed directly to a 50-ohm circuit.

13. XTAL CALIBRATOR switch

    1 MHz position—Provides crystal calibration at each multiple of 1 MHz.

    OFF position — disables calibration oscillators.

    100 KHz position—Provides crystal calibration points at each multiple of 100 kHz.

14. Speaker (behind dial)—Provides audible "zero beat" for crystal calibration procedure.

15. MODULATION switch

    AC OFF position—turns off unit. Unit is on in all other positions.

    CW position — Provides unmodulated CW (continuous wave) output.

    INT position — Provides 400 Hz internally modulated output.

    EXT position—Provides externally modulated output. The external modulation voltage is connected to EXT MOD jacks when using this switch position.

    400 Hz OUT position—Provides 400-Hz output at the EXT MOD jacks.

16. MOD jacks—Input jacks for external modulation and output jacks for 400-Hz tone. Universal binding post type jacks accept banana plug, meter leads, spade lugs, etc. Black post is grounded, red post is audio high.

PRELIMINARY SET-UP

1. Connect the plug of the ac power cord to a 117-volt, 50/60 Hz ac power outlet.
2. To turn on the signal generator, set the MODULATION switch **15** to the CW position. The pilot lamp **1** should light.
3. Set the XTAL CALIBRATOR switch **13** to the OFF position.
4. Set the RANGE switch **8** to the desired frequency range.
5. Set the dial **5** to the desired frequency with the frequency control knob **6**
6. Connect the rf output cable to the RF OUT jack **11**. The cable supplied with the signal generator is normally used. It contains a built-in 50-ohm termination. However, if the rf output signal is to be applied directly to a 50-ohm circuit, an unterminated rf cable should be used. Such a cable can be made from a length of 50-ohm coaxial cable (RG-58A/U) terminated in a microphone type female connector on one end and the desired connector or terminations on the other end.
7. Connect the rf output cable to the equipment being tested. Connect the black lead to the chassis first, then the red lead to the signal injection point.

PRECAUTIONS

A. When performing stage-to-stage measurements, always use a dc blocking capacitor between the red probe of the rf output cable and the circuit into which the signal is injected. This protects the attenuators of the signal generator from possible damage by the dc from the circuit under test. Trim the capacitor leads as short as possible, while still permitting adequate length for connections. The value of the blocking capacitor is dependent upon the frequency of the rf output signal. Suggested values are:
Ranges A and B: .1 uF, 400 V
Ranges C and D: .01 uF to .02 uF 400 V
Ranges E, H_2, H_4: 1000 pF

B. If the equipment into which the rf signal is being injected uses an ac powered, transformerless power supply, always use an isolation transformer between the 117-volt outlet and the equipment to prevent electrical shock and possible damage to the equipment. The equipment chassis becomes grounded through the rf signal generator when the rf cable is connected.

C. When connecting the rf output cable to equipment under test, always connect the black lead to the equipment chassis first. Otherwise, a transient voltage spike may occur when the connection is made that may damage transistorized equipment.

D. Use a dc blocking capacitor in series with the black lead of rf or 400-Hz output cables if other than chassis reference is used in equipment which has its chassis at earth ground. The black terminal of the EXT MOD jacks and the black probe of the rf cable are at earth ground potential through the 3-wire power plug. Serious damage to equipment could result by using a direct connection.

SETTING THE SIGNAL LEVEL

1. Be sure the output is terminated in a 50-ohm load.
2. Set the MODULATION switch **15** to the CW position.
3. Set the METER switch **2** to the CARRIER position.
4. Determine the amount of attenuation required to produce the desired output level (refer to the accompanying table). The desired output level may be in millivolts, microvolts, or dB, but must be converted to dB to correspond with the labelling on the controls. In this unit 0 dB = 100 millivolts into a 50-ohm load.
5. Place as many ATTENUATOR selectors **10** in the IN position as required to come within 0 to + 5 dB of the desired total attenuation. All the other ATTENUATOR selectors **10** must be in the OUT position.
6. Set the FINE ATTENUATOR control **9** for the additional attenuation, as indicated on the meter **3** (this should always be in the 0 to —5 dB region of the meter scale).
The total of all ATTENUATOR selectors and the meter reading equals the total attenuation below the 0 dB (100 millivolt) reference level.
7. Higher levels of output are possible but seldom required. Levels above + 2 dB must be measured with external equipment. At these higher levels, the meter **3** will peg, but no damage will occur since the meter is protected against overload damage. For output levels above + 2 dB, connect an rf voltmeter to measure the output signal level and adjust the FINE ATTENUATOR control **9** for the desired signal level.

NOTES

A. For greater accuracy, use an unmodulated signal level (MODULATION switch in CW position).

B. If the output is not terminated in 50 ohms, the output level is not calibrated. However, the meter and ATTENUATOR selectors still provide indication of relatively higher or lower level.

C. For ranges H_2 and H_4, which provide harmonic signals, the meter reads the level of the fundamental (Range E signal) only. The level of the harmonic is not indicated on the meter, but is proportional to the level of the fundamental signal.

DESIRED CONDITION

output signal level = 25 microvolts

PROCEDURE

- from table 25 microvolts = —72 dB total attenuation

  —20 dB
  —20 dB
  —20 dB
  —10 dB
  —2 dB

  —72 dB

- set three of the 20 dB ATTENUATOR selectors to the IN position (any three may be used)
- set the 10 dB ATTENUATOR selector to the IN position
- set the FINE ATTENUATOR for a meter reading of —2 dB

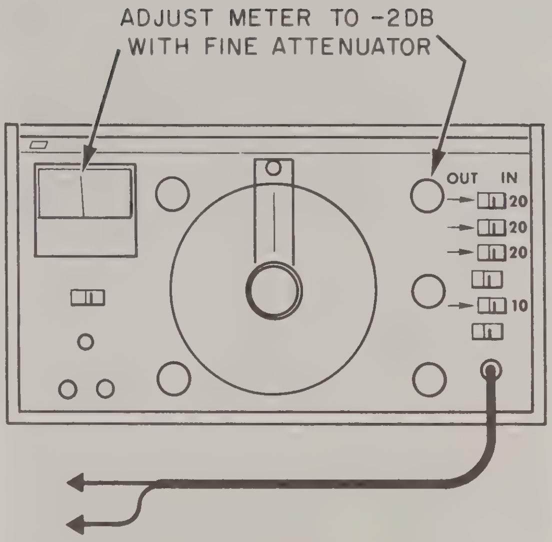
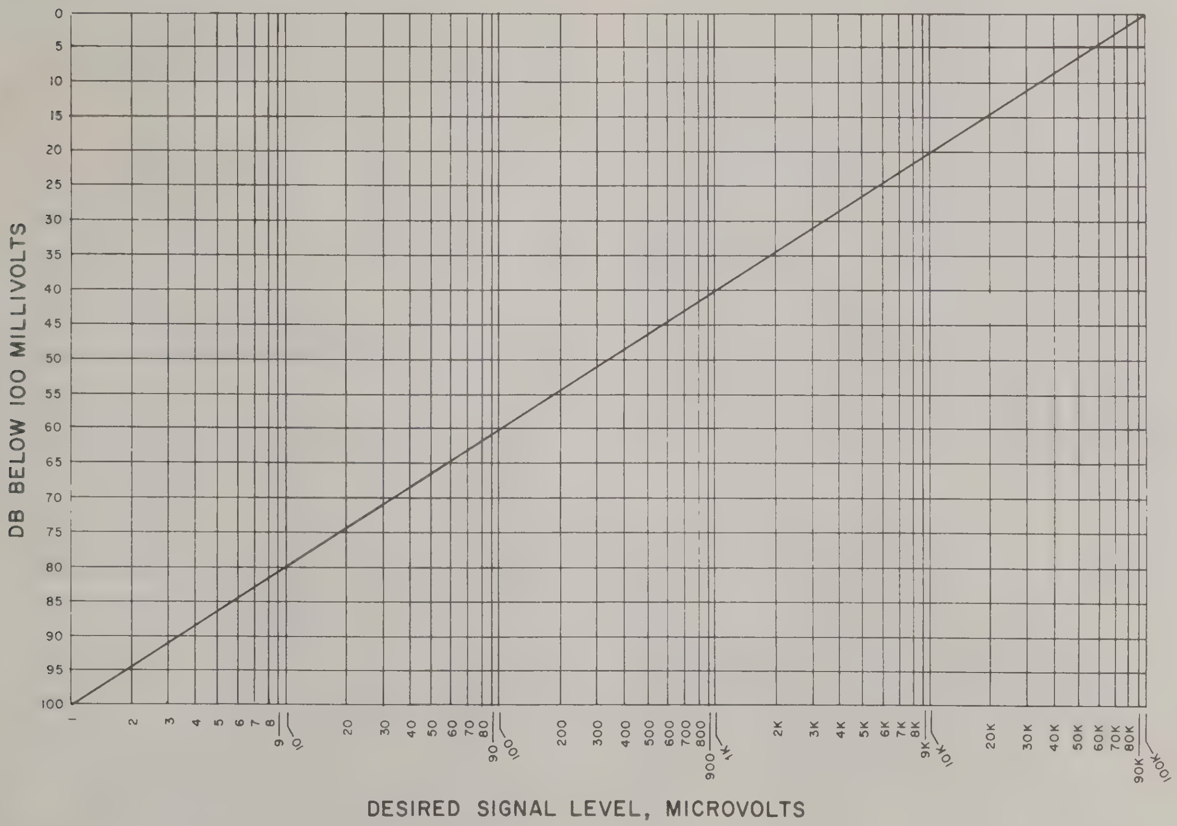


Figure 2. Typical Example, Setting Signal Level



DB-to-Voltage Conversion Table

SETTING MODULATION

1. To use 400 Hz internal modulation, set the MODULATION switch **15** to the INT position.
   To use external modulation, connect the audio signal to the EXT MOD jacks **16** (black = ground, red = audio high) and set the MODULATION switch **15** to the EXT position.
2. Set METER switch **2** to the % MOD position.
3. Adjust the MOD LEVEL control **4** for the desired percentage of modulation as indicated on the meter **3**.

The meter indicates percentage of modulation from 0 to 50%. Typical modulation for testing is 30%. Uncalibrated modulation greater than 50% is possible. Maximum modulation with the MOD LEVEL control fully clockwise is approximately 100%.

To determine per cent modulation for levels greater than 50 per cent, an oscilloscope may be used, provided the bandwidth of the oscilloscope is sufficient to observe the modulated signal. Refer to Figure 3. The voltage A is one-half the unmodulated carrier level. The level B is the modulation depth measured from the original unmodulated carrier level. The ratio of B to A is used to determine per cent modulation:

Modulation, per cent, = B/A x 100

CRYSTAL CALIBRATION

The crystal calibrator uses the "zero beat" method to obtain a high degree of frequency dial accuracy. It operates as follows. A crystal controlled oscillator produces calibration signals that beat with the signal generator output. When the two frequencies are separated by only a small amount, the difference frequency is in the audio range and is heard as an audio tone (whistle) in the speaker. As the signal generator output frequency approaches the crystal oscillator frequency, the pitch of the audio tone decreases. When both signals are the same frequency, a "zero beat" occurs where no tone is heard in the speaker. If the adjustable oscillator is tuned in either direction from the "zero beat" frequency, the tone is heard. The crystal controlled oscillator is rich in harmonics, which provides calibration points at each multiple of the crystal frequency.

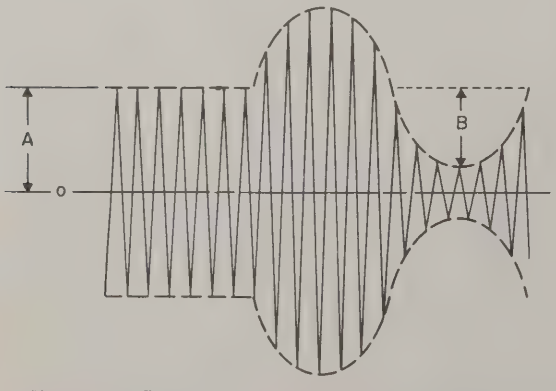


Figure 3. Amplitude Modulation Percentage

NOTE

Set the output level before setting the frequency. Although the oscillator and attenuators are isolated by an emitter follower, slight frequency pulling can occur when the FINE ATTENUATOR is adjusted or step attenuators are switched in and out.

1. Set the cursor marker **7** to the center of its travel.
2. Select the desired frequency range with the RANGE switch **8**.
3. Set the dial **5** to the desired frequency with the frequency control **6**.
4. For ranges A, B and C, set the XTAL CALIBRATOR switch **13** to the 100 KHz position. For ranges D, E, and H_2 H_4, set the XTAL CALIBRATOR switch **13** to the 1 MHz position. (The 1 MHz position can also be used for range C, but the calibration points are widely separated.)
5. Set the dial **5** to the nearest calibration frequency as follows:

   If the XTAL CALIBRATOR switch is in the 100 KHz position, calibration points occur at each multiple of 100 kHz. If the XTAL CALIBRATOR switch is in the MHz position, calibration points occur at each multiple of 1 MHz.
   On range H_2 calibration points occur at multiples of 2 MHz, and on range H_4 calibration points occur at multiples of 4 MHz.
6. Carefully set the dial **5** to obtain the "zero beat". A properly set "zero beat" is identified as a very precise dial setting where rocking the dial in either direction will produce a whistle.

   NOTES

   A. At higher frequencies, the "zero beat" whistle is progressively weaker. Listen carefully for the "zero beat" whistle at the high end of range C and the high end of ranges E, H_2 and H_4.

   B. Some less predominant beat frequencies are audible at other than calibration points. Disregard theses tones and use only multiples of 100 kHz or 1 MHz.
7. Carefully set the cursor marker **7** to exactly align with the calibration frequency mark on the dial. The dial is now calibrated for all frequencies near the calibration point.
8. Set the XTAL CALIBRATOR switch **13** to the OFF position.
9. Carefully readjust the dial **5** to the desired output frequency.

EXAMPLE

Desired Condition: Calibrated 455 kHz output
Procedure:

RANGE switch ....B
XTAL CALIBRATION switch ....100 kHz
Dial ....50 (500 kHz); as read on scale B (nearest calibration point)
Tune dial in vicinity of 50 for "zero beat"
Adjust cursor marker to exactly 50 on dial
XTAL CALIBRATION switch ....OFF
Set dial to ....45.5 (455 kHz)

ALIGNING AM BROADCAST BAND RECEIVERS

(Refer to Figure 4)

NOTES

A. For best results, always follow the manufacturer's alignment procedure explicitly. However, if such procedure is not available, or only a condensed procedure is available, the following general instruction should be helpful for aligning most AM broadcast band radios (and the AM portion of AM-FM radios). Since circuit designs vary widely, some of the circuits shown may not be included in all radios, and other radios may have additional circuits or a different arrangement of components.

B. If a transformerless ac-dc receiver is to be aligned, be sure to use an isolation transformer.

C. When preparing to align transistorized receivers, turn off all equipment while connections are being made or being removed to eliminate the possibility of transient voltage spikes which could damage transistors.

D. Keep the signal output level of the signal generator low. Use just enough signal to provide a usable reading on the alignment meter. High signal levels may overdrive amplifiers, resulting in improper alignment. As the receiver is aligned, the meter reading increases. Continuously reduce the signal generator output level, as required, to maintain approximately the original meter reading.

1. Disable the local oscillator as recommended by the radio manufacturer, or short across the oscillator coil.
2. Set the volume control of the receiver to the normal listening level.
3. Connect a VTVM to measure the audio voltage across the speaker voice coil. Use a convenient ac voltage scale.
4. Connect the rf cable from the signal generator to inject a signal at the input of the converter. First, connect the black probe to signal ground near the signal injection point, then connect the red probe through a series dc blocking capacitor to the converter input.
5. Set the signal generator to the receiver i-f frequency. Most AM broadcast band receivers use a 455-kHz i-f signal, except automobile radios, some of which use a 262-kHz i-f signal.

To set the rf signal generator at 455 kHz:

RANGE switch ....B

Dial ....45.5 (scale B)

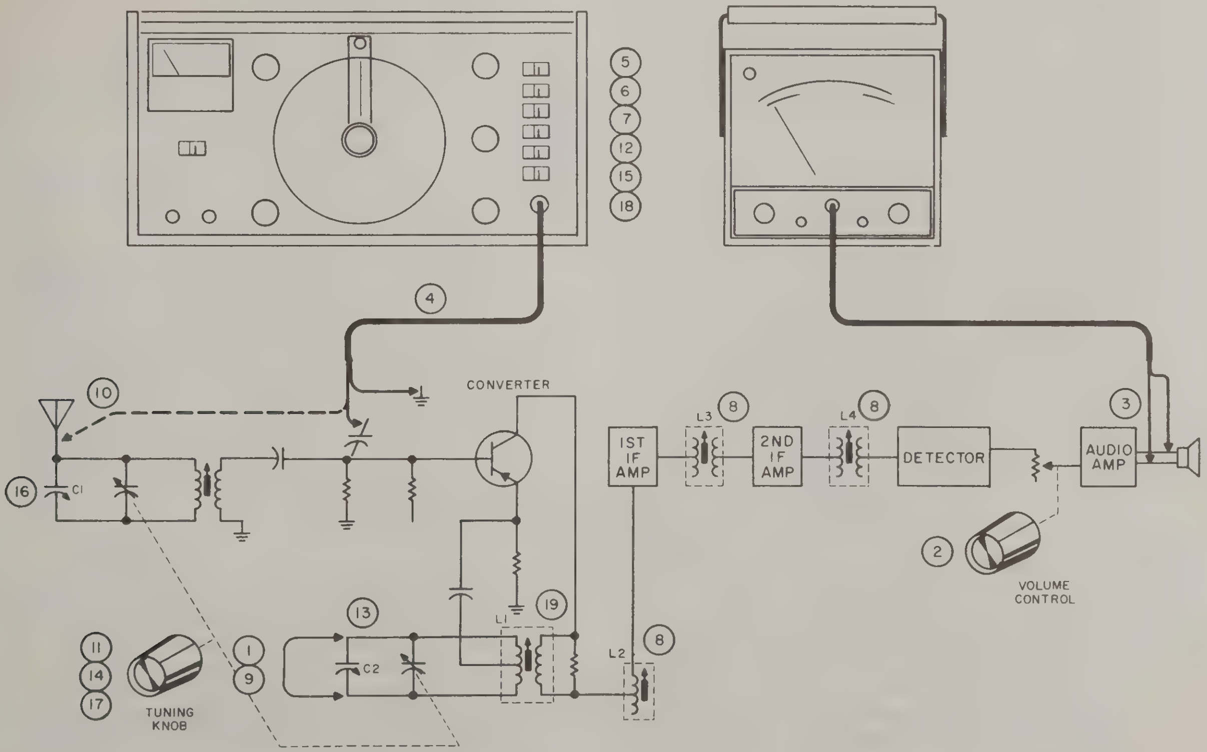


Figure 4. Typical AM Broadcast Band Receiver Alignment

6. Modulate the signal generator output with a 400-Hz audio signal at 30% modulation.

   Set the rf signal generator controls as follows:
   MODULATION switch ....INT
   METER switch ....% MOD
   MOD LEVEL control...Adjust for 30% reading on the modulation meter

7. Set the controls on the signal generator to provide the minimum signal level that will provide a usable meter reading on the VTVM.

   METER switch ....CARRIER

   FINE ATTENUATOR ....Adjust for 0 dB on carrier meter.

   ATTENUATOR selectors ....Place as many in the IN position as required to obtain proper signal level.

   A satisfactory level should be a comfortable listening level in the speaker. The volume control may be readjusted if audio output is excessive with the rf signal fully attenuated.

8. Starting at the detector and working toward the antenna, adjust each of the i-f coils for maximum meter reading on the VTVM (in Figure 4, adjust L4, L3, then L2 in that sequence). Reduce the signal generator output level as required to maintain suitable meter reading and speaker volume. REPEAT THE ADJUSTMENTS UNTIL NO FURTHER IMPROVEMENT CAN BE OBTAINED.

   If the radio is badly misaligned, it may be necessary to inject the signal directly into the 2nd i-f amplifier to adjust L4, then move the injection to the input of the 1st i-f amplifier to adjust L3, and to the input of the converter to adjust L2.

9. Enable the local oscillator by removing the short from the oscillator coil.

10. Move the red probe of the rf cable to the antenna input of the receiver.

    If the radio uses a ferrite loopstick antenna, wind several loops of insulated wire into a coil, connect the probes of the rf cable to the two ends of the coil, and place the coil in the vicinity of the antenna (See Figure 5). The signal radiated by the coil will be picked up by the antenna. Do not place the coil so close to the antenna that overcoupling will detune the antenna circuit.

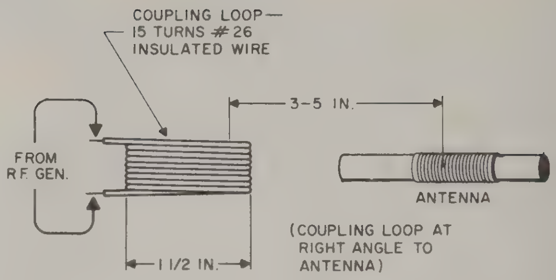


Figure 5. Signal Injection Coupling Loop for Ferrite Loopstick Antenna

11. Tune the receiver to 600 kHz.

12. Set the signal generator to 600 kHz as follows:
    RANGE switch ....B
    Dial ....60 (scale B)
    If necessary, readjust the signal level.

13. Adjust oscillator coil (L1) for maximum meter reading on the VTVM.

14. Tune the receiver to 1600 kHz.

15. Set the signal generator to 1600 kHz (1.6 MHz) as follows:
    RANGE switch C
    Dial ....1.6 (scale C)
    If necessary, readjust the signal level.

16. Adjust the oscillator trimmer capacitor (C2) for maximum meter reading on the VTVM.

17. Tune the receiver to 1400 kHz.

18. Set the signal generator to 1400 kHz (1.4 MHz) as follows:
    RANGE switch C
    Dial ....1.4 (scale C)
    If necessary, readjust the signal level.

19. Adjust the antenna trimmer capacitor (C1) for maximum meter reading on the VTVM.

20. Repeat steps 11 through 19 until no further improvement can be obtained.

ALIGNING FM BROADCAST BAND RECEIVER

(Refer to Figure 6)

NOTES

A. An FM signal generator is not required for proper alignment of an FM receiver. Excellent results may be obtained by injecting an unmodulated carrier signal from an rf signal generator and measuring the dc voltage output of the ratio detector (discriminator in many receivers).

B. For FM receivers and tuners, it is important to follow the manufacturer's procedure. However, the accompanying procedure is very typical and applies to many FM receivers (and the FM portion of AM-FM radios). In all cases, the procedure exemplifies the use of the rf signal generator for alignment.

C. If a transformerless ac-dc receiver is to be aligned, be sure to use an isolation transformer.

D. When preparing to align transistorized receivers, turn off all equipment while connections are being made or being removed to eliminate the possibility of transient voltage spikes which could damage transistors.

E. Keep the signal output level of the signal generator low. Use just enough signal to provide a usable reading on the alignment meter. High signal levels may overdrive amplifiers resulting in improper alignment indications. As the receiver is aligned, the meter reading increases. Continuously reduce the signal generator output, as required, to maintain approximately the original meter reading.

1. Disable the local oscillator as recommended by the radio manufacturer, or short across the oscillator coil.
2. If the radio has an AFC switch, place it in the OFF position.
3. Connect a VTVM to measure the dc voltage output of the ratio detector (discriminator in many receivers) at test point A. Use a low range (1.5 volt) dc voltage scale.

NOTE

Many variations in circuit design cause the reference point to vary widely. Most often, chassis ground is *not* the reference point for this reading. Refer to the manufacturer's instructions for the exact location of test point A and the reference point.

4. Connect the rf cable from the signal generator to inject a signal at the input of the mixer (converter in some radios). First connect the black probe to the signal ground near the signal injection point then connect the red probe through a series dc blocking capacitor to the mixer input.
5. Set the controls on the signal generator to provide an unmodulated carrier signal at precisely 10.7 MHz as follows:

MODULATION switch ....CW

RANGE switch C

Crystal calibrate at 11 MHz (see crystal calibration instructions).

XTAL CALIBRATION switch ....OFF

Dial 10.7

6. Set the controls on the signal generator to provide the minimum signal level that will provide a usable meter reading on the VTVM.

METER switch	CARRIER
FINE ATTENUATOR	Adjust for 0 DB on carrier meter.
ATTENUATOR selectors	Place as many in the IN position to obtain proper signal level.

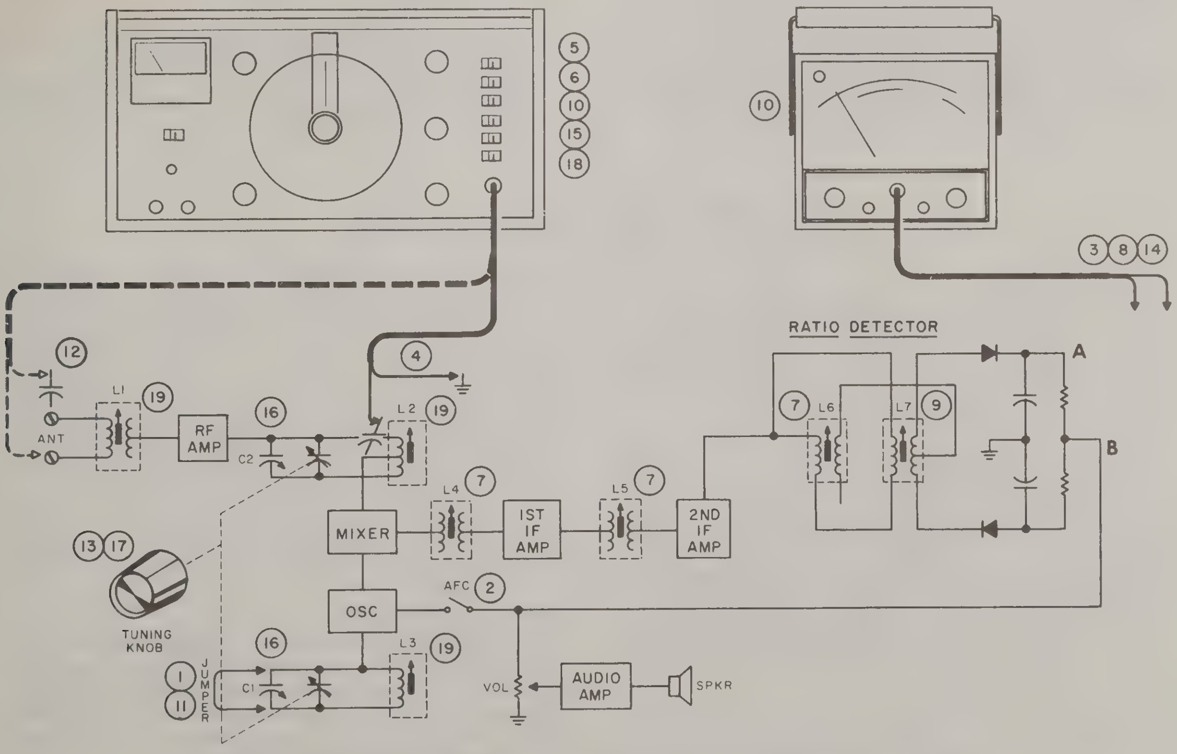


Figure 6. Typical FM Broadcast Band Receiver Adjustment

7. Beginning with the primary coil of the ratio detector (or discriminator) and progressing toward the antenna, align each i-f coil for maximum meter reading on the VTVM (in figure 6, adjust L6, L5, and L4 in that order). Reduce the signal generator output level as required to maintain a small meter reading. REPEAT THE ADJUSTMENTS UNTIL NO FURTHER IMPROVEMENT CAN BE OBTAINED.

   If the radio is badly misaligned, it may be necessary to inject the signal directly into the 2nd i-f amplifier to adjust L6, then move the injection to the input of the 1st i-f amplifier to adjust L5, and to the input of the mixer to adjust L4.

8. Change the VTVM connections to measure the voltage at test point B. Again refer to the manufacturers' data for the exact location of test point B and the reference point to be used for this measurement.

9. Adjut the secondary coil (L7) of the ratio detector (discriminator) for an exact zero meter reading. Adjusting the coil in one direction must cause a positive dc voltage, and a negative dc voltage if adjusted in the other direction. Use the most sensitive scale of the VTVM for the most accurate reading.

10. Check ratio detector (discriminator balance. If unbalanced, repeat i-f alignment until balance or near balance can be obtained.

    Balance should be checked as follows:

    a. Set the signal generator dial equal amounts above and below the 10.7 MHz i-f center frequency. Refer to the radio manufacturer's data for the specific amount, usually approximately 100 kHz. If 100 kHz is used, dial settings of 10.6 MHz and 10.8 MHz should be used.

    b. Read the voltage on the VTVM at each of the frequencies. The voltages must be equal and of opposite polarity.

    c. Use care in setting the dial of the signal generator an equal amount above and below the center frequency, and in reading the VTVM. Inaccuracies will result in unsatisfactory alignment.

11. Enable the local oscillator by removing the short across the coil.
    the coil.

12. Move the rf cable to the antenna terminals of the radio.

13. Reconnect the VTVM as in step 3.

14. Tune the radio to 90 MHz.

15. Set the signal generator to 90 MHz.

    RANGE switch .... H_2
    Dial 90

    Select a signal level that will produce a small voltage reading on the VTVM.

16. Adjust the oscillator, mixer and antenna coils L3, L2 and L1 for maximum meter indication on the VTVM.

17. Tune the radio to 108 MHz.

18. Set the signal generator to 108 MHz. If necessary, readjust the output level for a usable meter reading.

19. Adjust rf trimmer capacitors C1 and C2 for maximum meter indication on the VTVM.

20. Repeat steps 13 through 19 until no improvement can be obtained.

ALIGNING TELEVISION RECEIVERS

SOUND I-F

The rf signal generator may be used to align the sound i-f section of television receivers. The procedure is essentially the same as for the i-f portion of FM broadcast band receivers except that a 4.5-MHz i-f signal is used.

VIDEO I-F

Proper alignment of the video i-f section requires close adherence to the television set manufacturer's alignment procedure. Due to the wide bandwidth involved, stagger tuning is required. Refer to the manufacturer's instructions for the frequency at which each coil is to be tuned. Although the rf signal generator can be used for such alignment by setting it to the specified frequency for each coil and tuning the coil for maximum output from the i-f section, a more common and preferable method is to use a sweep generator.

Set up the sweep generator to inject a signal into the i-f section which covers the entire video i-f spectrum and display the output of the i-f section on an oscilloscope. The rf signal generator is used as a marker generator. The marker generator creates a "pip" (visible marker) on the oscilloscope pattern. By adjusting the frequency of the rf signal generator, the marker can be moved to any required position, thus measuring data such as the lower bandpass limit, upper bandpass limit, adjacent channel rejection, effectiveness (proper adjustment) of trap circuits, and any other data required. Since the rf signal generator is continuously adjustable, all points on the video i-f response curve can be checked for waveshape configuration and bandwidth. Likewise, chroma and sound response curves may be checked.

TUNER ADJUSTMENT

The harmonic output of the rf signal generator in ranges H and H covers the VHF television spectrum. This output can be used as a marker signal when aligning VHF tuners with a sweep generator. Refer to the television manufacturer's instructions for the proper alignment procedure.

USING THE RF SIGNAL GENERATOR TO LOCATE TROUBLES

The rf signal generator is an excellent instrument for locating defective circuits in equipment that can be tested with 400-Hz audio, and CW or amplitude modulated rf signals. Not only broadcast band AM and FM receivers, but short wave, marine band, amateur and two-way communications receivers plus almost any electronic equipment using tuned rf circuits can be tested. Audio, i-f and rf sections of receivers can be tested with this single instrument.

The "signal substitution" technique of troubleshooting is used to quickly locate the defective circuit. The "signal substitution" technique uses the output from the rf signal generator to substitute for the missing signal in the defective radio. The signal is usually injected at the speaker first, then moved one stage at a time toward the antenna until no output is obtained. The stage which produces no output is defective. All series components in the defective stage, such as coupling capacitors, transformers, etc. should be checked by the signal injection method to isolate the defect to as small an area as possible.

A typical example of the technique, using the rf signal generator to troubleshoot an AM receiver follows (also refer to Figure 7):

1. Connect test leads from the EXT MOD jacks of the signal generator to both sides of the speaker voice coil.

   CAUTION

   Use a dc blocking capacitor in series with the red probe to the high side of the speaker voice coil if there is any dc potential at this point. If the radio chassis is common to earth ground and the speaker voice coil is not common to the chassis, also use a dc blocking capacitor in series with the black probe.
2. Set the MODULATION switch to the 400 Hz OUT position.
3. Adjust the MOD LEVEL control for audible 400-Hz tone from the speaker. If the speaker is defective, no tone will be heard.
4. Move the test probes to the input of the audio output amplifier. Connect the black probe to chassis and use the red probe for signal injection. When testing push-pull amplifiers, inject the signal into each amplifier individually and listen for equal volume speaker output from each. If no tone is heard or unbalanced outputs are obtained, the stage is defective.

   Since amplification takes place in the stage, the tone heard in the speaker should be at higher volume than in step 3. Reduce the signal level as required with the MOD LEVEL control for a comfortable listening volume.
5. If the output in step 4 was normal, move the signal injection point to the input of the driver. The gain of the stage should provide a louder tone in the speaker. No tone means that the driver or the coupling to the output amplifier is defective.
6. Move the injection to the input side of the volume control. With the volume set to maximum, there will be less speaker output than in step 5 because an emitter follower has no gain. Check the volume control for smooth operation. No speaker tone indicates a defective component in the emitter follower stage.

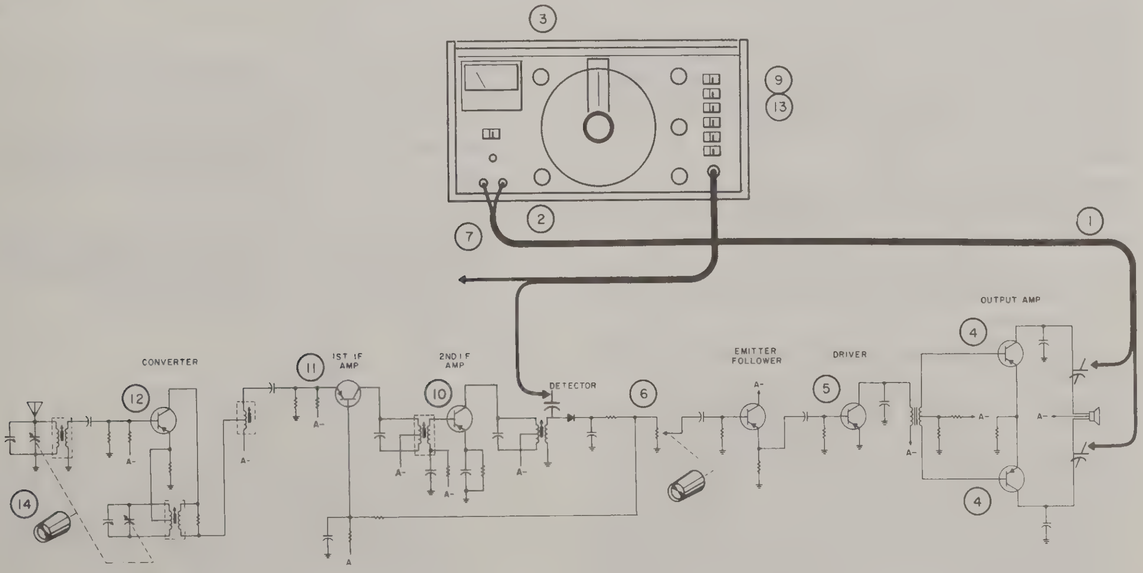


Figure 7. Typical Troubleshooting Technique Using RF Signal Generator

7. The audio section testing is completed, and the 400-Hz output is no longer required. Remove the test leads from the EXT MOD jacks and continue by testing the i-f section.

8. Connect the rf cable from the signal generator RF OUT jack to the input of the detector. Use a dc blocking capacitor in series with the red probe and connect the black probe to chassis.

9. Set the controls on the signal generator to produce a modulated 455-kHz i-f signal output as follows:

MODULATION switch	INT
METER switch	% MOD
MOD LEVEL	30% (as indicated on modulation meter)
RANGE switch	B
Dial	45.5 (scale B)
METER switch	CARRIER
FINE ATTENUATOR	0 dB on carrier meter
ATTENUATOR selectors	Set as many to IN as possible with the 400-Hz tone audible in the speaker

If no tone is heard, the detector is defective.

10. Move signal injection to the input of the 2nd i-f amplifier. The gain of the stage should cause a louder tone from the speaker than in step 9. Reduce the signal level to maintain a comfortable listening level. If no tone is heard, the 2nd i-f amplifier is defective.

11. Move signal injection to the input of the 1st i-f amplifier. The speaker volume should again increase if the stage is operating normally.

12. Move signal injection to the input of the converter. If the tone is still aduible, the i-f section is ok. Continue testing in the rf section.

NOTE

A significant drop in volume as the injection is moved from the detector toward the converter should be checked as a possible source of trouble. It is possible that a defect has been detected, but due to 455-kHz signal radiation it is picked up at a subsequent point in the circuit after the defect with sufficient strength to provide an audible output. Keeping the signal level as low as possible for adequate testing helps reduce radiation and its related possible misinterpretation of test results.

13. With the rf cable still connected to the input of the converter, set the signal generator to any convenient broadcast band frequency (for example, 1000 kHz). Use a moderate signal level.

14. Tune the receiver to approximately the same frequency as selected in step 13. Search for the signal by tuning, as if tuning for a station. If no signal can be found, the local oscillator portion of the converter is defective. If the 400-Hz tone can be tuned in, the antenna circuit is defective.

OTHER USES FOR THE RF SIGNAL GENERATOR

ALIGNMENT

The rf signal generator may be used for alignment of receivers operating on short wave bands, marine bands, and most other frequency bands as well as the AM and FM broadcast bands. Refer to the manufacturer's instructions for alignment procedure.

MEASURING GAIN (Refer to Figure 8)

The voltage gain of an rf amplifier (or group of amplifiers) may be measured as follows:

1. Connect a VTVM or oscilloscope to measure the signal level at some convenient point in the output circuit.
2. Connect the rf signal to the output of the stage being tested.
3. Adjust the signal level for a convenient measurement level on the VTVM or oscilloscope. The signal level must be within the approximate range of normal operation for the stage. Let us assume, for an example, that the VTVM reads 1 volt. Using the carrier meter reading and the step ATTENUATOR settings, note the total attenuation in dB. Let us assume, for example, that the total attenuation is —54 dB.
4. Move the signal injection to the input of the amplifier.
5. Using the step ATTENUATOR's and FINE ATTENUATOR control, reduce the signal level until the VTVM or oscilloscope shows the same reading as in step 3. Again note the total attenuation. Let us assume for our example, that this total attenuation is —78 dB.
6. The gain of the stage (or group of stages) being tested is the difference between the total attenuation in step 5 and the total attenuation in step 3. In our example, the gain is 24 dB.

78 dB
—54 dB
24 dB gain

NOTE

This is a check of voltage gain, not power gain. Variations in impedance between the two injection points can substantially affect the reading in dB. Losses of non-gain circuits may be checked by the same method as gain.

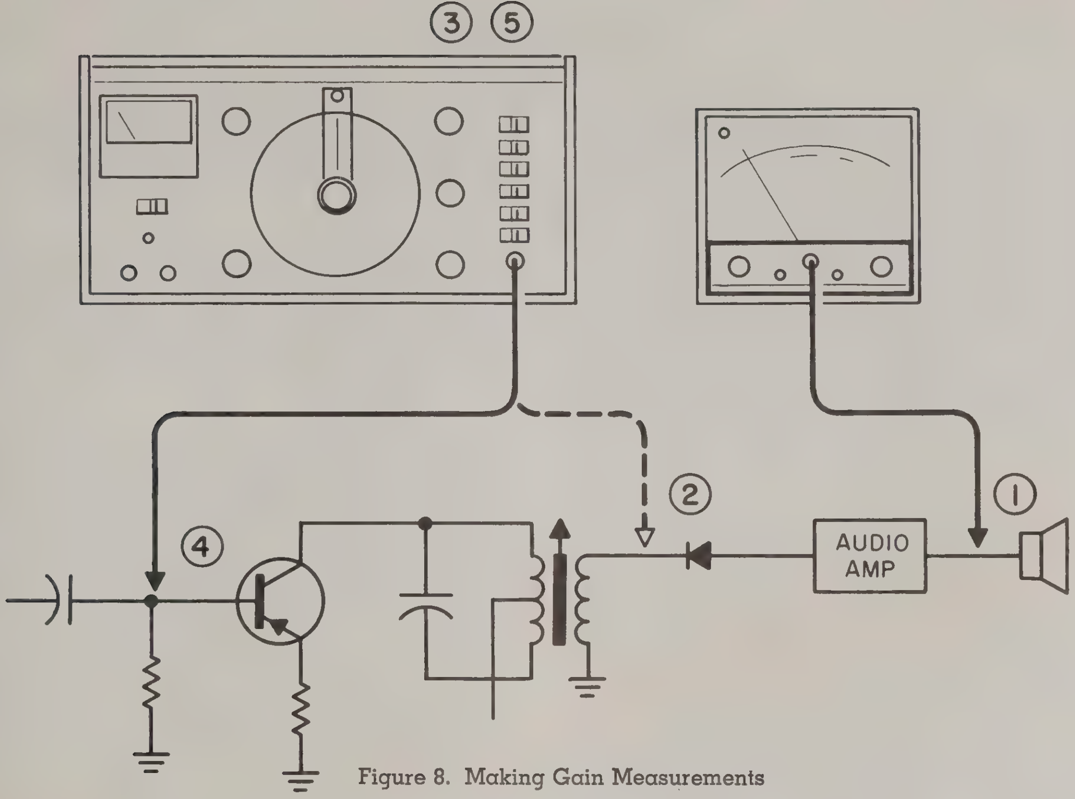
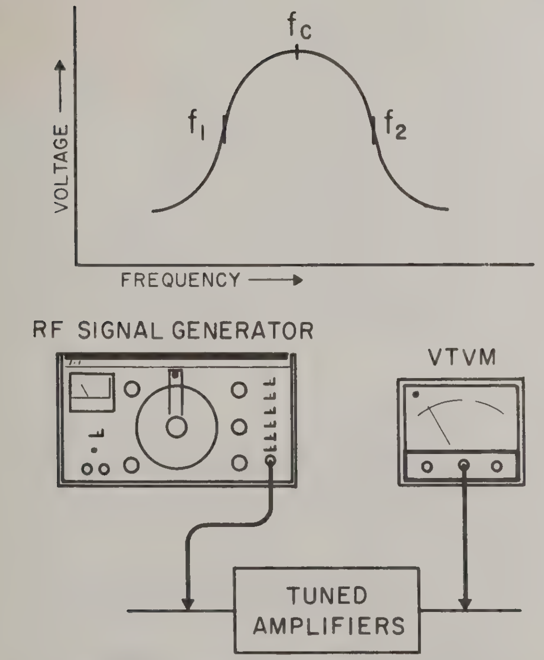


Figure 8. Making Gain Measurements



At f_c the VTVM reads maximum.

At f_1 and f_2 the VTVM reads $\frac{\text{max}}{2}$ (—6 dB)

Bandwidth = $f_2 - f_1$

Figure 9. Measuring Bandwidth

MEASURING BANDWIDTH (refer to Figure 9)

The bandwidth of a stage or group of stages (such as an entire i-f section) may be measured as follows:

1. Connect a VTVM or oscilloscope to measure the output level of the circuit being measured.
2. Inject rf signal at the input of the circuit being measured.
3. Tune the frequency of the signal generator for maximum output on the VTVM or oscilloscope (f_c).
4. Decrease the frequency of the signal generator until the VTVM or oscilloscope reads one half the value in step 3. Note the frequency (f_1).
5. Increase the signal generator frequency past the maximum VTVM reading until the VTVM reads the same as in step 4. Again note the frequency (f_2).
6. The difference between f_1 and f_2 is the bandwidth.

NOTE

This procedure uses the standard —6 dB voltage points (one half maximum voltage) for measurement of bandwidth. Other criteria may be substituted if desired.

Another method of measuring bandwidth is to use a sweep generator as the signal source, the rf signal generator as a marker generator, and display the results on an oscilloscope. This method presents a visual display similar to the response curve shown in figure 9.

CIRCUIT DESCRIPTION

The following circuit description is made with reference to simplified block diagram Figure 10 and the schematic diagram. Oscillator stage Q-1 is operative for all ranges. The desired operating band is selected by range selector switch S2, and tuning is performed by tuning capacitor C-41. The output of oscillator Q-1 is coupled to buffer amplifier Q-2. This stage isolates the oscillator from the modulator and detector buffer stages. In addition, the emitter follower configuration of this stage provides a low output impedance which is applied across FINE ATTENUATOR control R-60. Two outputs are provided from buffer amplifier Q-2. The first is applied through FINE ATTENUATOR R-60 to the input of the modulator Q-3. The second output is coupled to detector buffer amplifier Q-4.

The modulator stage operates as a variable gain RF amplifier. The gain of this stage is varied by the application of audio voltage from the MOD LEVEL control R-79. With a fixed RF input determined by the setting of R-60, the instantaneous output is varied at an audio rate. Either internal or external audio modulation can be employed. Internal modulation is provided by the two-stage audio oscillator consisting of Q-9 and Q-10. The output frequency is approximately 400 Hz. The output of this oscillator is coupled to MODULATION selector switch S-3. The generator can be modulated externally by application of an audio voltage to the EXT MOD jack. This audio signal is also coupled to the MODULATION selector switch S-3. Either the internal or external modulation is supplied to MOD LEVEL adjustment R-79 by the MODULATION selector switch S-3. The amplitude of the audio signal is sampled by modulation detector D-8 which provides a d-c voltage proportional to the audio signal level. This is applied to METER switch S-4. When the METER switch is in the % MOD position, the modulation detector output is switched to meter amplifier Q-11 and from there to the carrier and modulation meter M-1. The meter is calibrated to indicate per cent modulation relative to the amplitude of the modulating voltage supplied. In the CW position of the MODULATION switch no audio voltage is applied to modulator Q-3.

MODULATION switch S-3 is designed to make available at the EXT MOD jacks the output of the internal audio oscillator when the switch is in the 400 HZ OUT position. This signal is useful in signal tracing audio circuits.

The RF output level of modulator Q-3 is sampled by RF detector D-3. The d-c output of the detector is supplied to METER switch S-4. When the METER switch is in the CARR position, the detector voltage is supplied to meter amplifier Q-11 and from there to the carrier and modulation meter M-1. The relative output level of modulator Q-3 is indicated on meter M-1 in decibels.

The output of modulator Q-3 is coupled into the attenuator switching network consisting of switches S-5 through S-10. The output of the attenuator is supplied to RF OUT jack J-1. The RF cable provided with the generator has a built-in 50Ω termination. When this cable is connected to the RF OUT jack J-1, the generator is effectively terminated in 50Ω. Under these conditions (a 50Ω output termination) a 0 db indication on meter M-1 indicates an RF signal level of 100,000 μv at the output of modulator Q-3. The actual RF voltage level appearing at RF OUT jack J-1 is determined by the settings of ATTENUATOR switches S-5 through S-10 as described in the OPERATING section of this manual.

Internal reference oscillators are provided for calibration of the RF carrier frequency. Crystal controlled 1 MHz oscillator Q-5 and 100 KHz oscillator Q-6 are provided for this purpose. The XTAL CALIBRATOR switch S-2 selects either the 1 MHz oscillator output or the 100 KHz oscillator output and applies the selected signal to detector Q-7. The calibration signal is then heterodyned against the carrier signal supplied through detector buffer Q-4. When the difference frequency is within the audible frequency range, this is amplified by audio amplifier Q-8 and deliverd to the speaker. The audio frequency decreases as the frequency of the generator approaches a harmonic of either the 1 MHz or the 100 KHz oscillator. When the frequencies are equal, a zero beat indication is obtained at the speaker.

CALIBRATION OF 100 KHz OSCILLATOR

The 100 Kilohertz calibration oscillator provided in the Model E-200D is of the L-C type and is extremely stable with respect to temperature and aging. If it is ever desired to check the accuracy of this oscillator, proceed as follows:

1. Remove the plug button provided on the bottom of the generator case. This makes the 100 KHz oscillator coil accessible for adjustment.
2. Set the RANGE SWITCH to Band A.
3. Set MODULATION SWITCH to CW position.
4. Set the TUNING DIAL to 10 on the A band (100 KHz). No output level adjustments are required.
5. Set the XTAL CALIBRATOR SWITCH to the 1 MHz position.
6. Slowly adjust the frequency dial until an exact zero beat is obtained at the speaker output.
7. Set the XTAL CALIBRATOR SWITCH to the 100 KHz position.
8. Adjust the 100 KHz oscillator coil through the access hole on the bottom of the unit very slowly to obtain an exact zero beat indication at the speaker output.
9. Reset the XTAL CALIBRATOR SWITCH to the 1 MHz position and verify that the unit is at the exact zero beat position. The 100 KHz oscillator is now calibrated against the internal 1 MHz crystal oscillator.
10. Replace the plug button in the access hole on the bottom of the generator case.

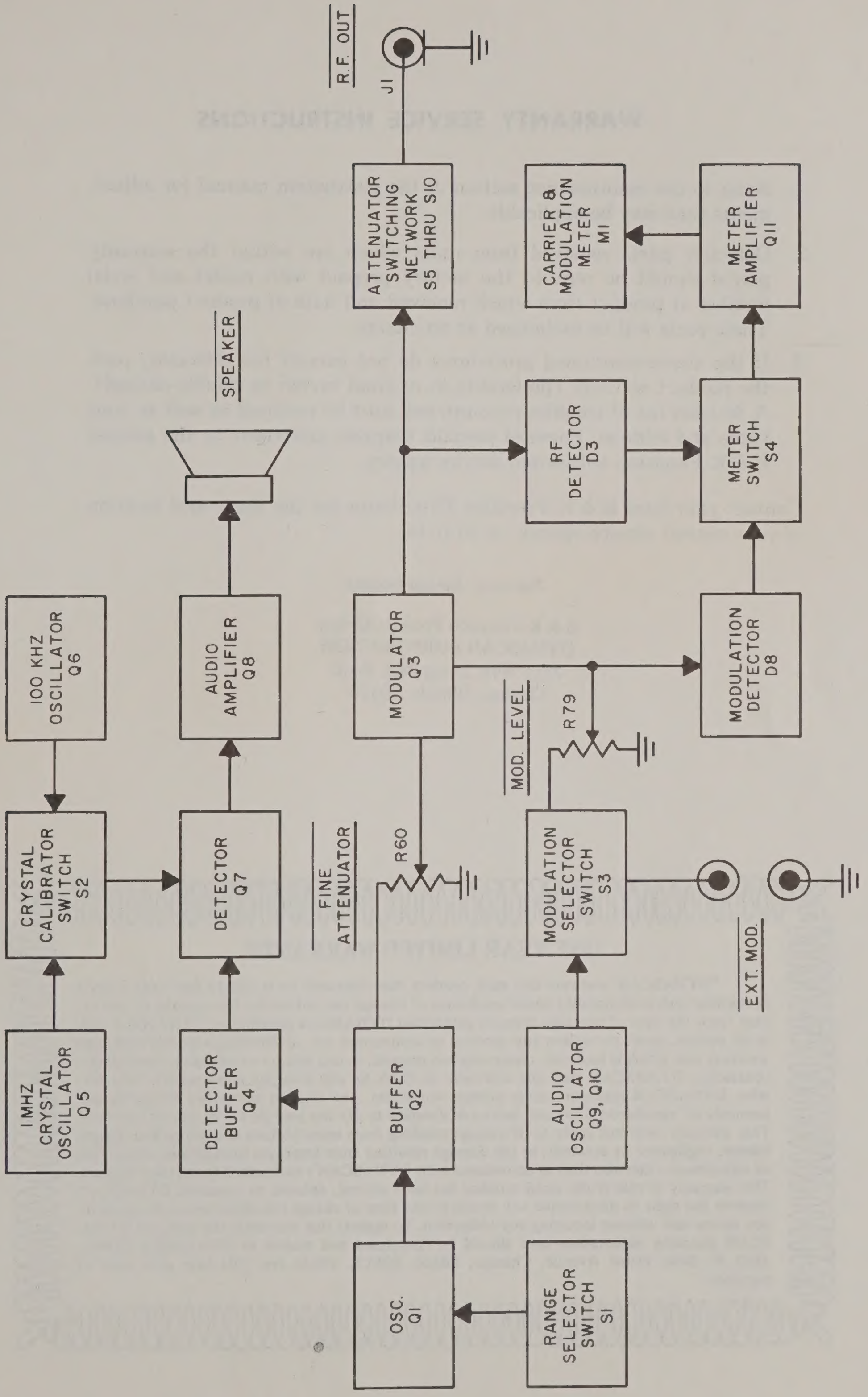


Figure 10. Model E200D Block Diagram

WARRANTY SERVICE INSTRUCTIONS

1. Refer to the maintenance section of the instruction manual for adjustments that may be applicable.
2. Defective parts removed from units which are within the warranty period should be sent to the factory prepaid with model and serial number of product from which removed and date of product purchase. These parts will be exchanged at no charge.
3. If the above-mentioned procedures do not correct the difficulty, pack the product securely (preferably in original carton or double-packed). A detailed list of troubles encountered must be enclosed as well as your name and address. Forward prepaid (express preferred) to the nearest B & K-Precision authorized service agency.

Contact your local B & K-Precision Distributor for the name and location of your nearest service agency, or write to

Service Department

B & K-Precision Product Group
DYNASCAN CORPORATION
2815 West Irving Park Road
Chicago, Illinois 60618

ONE YEAR LIMITED WARRANTY

"DYNASCAN warrants that each product manufactured by it will be free from defects in material and workmanship under conditions of normal use and service for a period of one (1) year from the date of purchase from an authorized DYNASCAN distributor. DYNASCAN will, at its option, repair or replace any product or component not conforming with the foregoing warranty and which is returned, transportation prepaid, to our factory or our authorized service contractor. *DYNASCAN shall not otherwise be liable for any damages, consequential or otherwise.* DYNASCAN makes no other express warranties. *Any implied warranties (including any warranty of merchantability) are limited in duration to (1) one year from the date of purchase.* This warranty does not apply to (i) damage resulting from unauthorized alterations and repairs, misuse, negligency or accident; or (ii) damage resulting from improper installation, connection or adjustment otherwise than in accordance with DYNASCAN's authorized Instruction Manual. This warranty is void if the serial number has been altered, defaced or removed. DYNASCAN reserves the right to discontinue any model at any time or change specifications or design without notice and without incurring any obligation. To register this warranty, the enclosed DYNASCAN warranty registration card should be completed and mailed to DYNASCAN CORP., 1801 W. Belle Plaine Avenue, Chicago, Illinois 60613, within ten (10) days after date of purchase.